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The Green Thumb

L. THIRTY-FIVE, NUMBER ONE

SPRING, 1978



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THE GREEN THUMB

SPRING, 1978

VOL. THIRTY—FIVE, NUMBER ONE

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The Green Thumb

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Editors

SPRING, 1978

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From Cemetery To Conservatory

Part V—

The Jewish Cemetery and The Pest House

Louisa Ward Arps

[Note. This is the fifth of a series of articles published in *The Green Thumb* telling the history of the land around the Denver Botanic Gardens. The sixth article will deal with the Capitol Hill reservoirs.]

The Jewish Cemetery

Cheesman Park was once the city cemetery, the Denver Botanic Gardens was once the Roman Catholic cemetery, and the 10 acres of land east of the northern part of the Gardens was once the Jewish cemetery. Today, the 660 foot square of land that belonged to the Hebrews is mostly covered with the concrete of two streets and a parking lot, and the water of a reservoir, but in 1903 a newspaper reported that the Jewish cemetery was "perhaps the most beautiful spot in the city." A neat frame fence enclosed it, shrubs dotted it, and trees lined the little country road that came down from Josephine Street and turned into the cemetery.¹

This landscape was possible only after 1888 when the first of three Capitol Hill reservoirs brought water to the top of the hill. Before that, graves were dug in dry prairie land, green only in the spring. Perhaps the first Jewish burial was in 1860, when the Hebrew Burial Association was organized. No record has been found that early, but a newspaper article dated May 16, 1866 stated that 12 Jews had been buried by then.

The first official record of a Jewish burial was for Feist Schayer, on July 16, 1865. This appears in the cemetery record book, a large book with few entries, carefully preserved at Temple Emanuel in Denver. The second entry was in October 1867, and from 1871 through 1875 eleven entries appear.³ This seems a small number but the total population of Denver in 1870 was only 4,731. After the middle 1870s Denver started to grow as did the numbers buried in the Hebrew cemetery. The last entry in the book is for 1910.

Perhaps Larimer, the real estate promoter who first claimed the top of Capitol Hill as a cemetery had designated 10 acres for the Jews. On August 3, 1866, J. J. Walley, an undertaker who had somehow acquired the cemetery business when Larimer left Denver, gave a quit claim deed for the 10 acres "known as the Jews' graveyard" to the Jewish Association and Congregation of Denver.² How much Walley charged the Jews is not recorded. (The fee on the quit claim deed was \$12.50.) But the title was voided when the U.S. Congress annulled Walley's claim to any public land. This was in 1870. Three years later Congress sold the city of Denver 160 acres for burial purposes at \$1.25 per acre. At the same price, the city sold 40 acres to the Roman Catholics, but no record has been found that the Jews bought their 10 acres at this time. The Jews base their claim to the land on an official map dated 1874 showing 10 acres belonging to the Hebrew Cemetery Association.⁴ (This association, incorporated in 1873, ran the cemetery until 1910 when Congregation Emanuel took charge.)

Graves Moved to Fairmount

Anticipating the time when the city would prohibit all burials in the new Capitol Hill residential section, in 1896 the Jews bought 6¾ acres of land at Riverside Cemetery, but still used the original graveyard at times. In 1911, partly by trade of unused ground at Riverside and partly by purchase, Congregation Emanuel acquired 15 acres of land in Fairmount Cemetery, which they named Emanuel. Thereupon, the Congregation moved the bones from Capitol Hill, a chairman and two witnesses supervising each operation, a meticulous method unlike the scandalous techniques employed at the city cemetery.⁵ The transfer was completed in 1923.

Land Sold to Water Commissioners

After the Jewish graveyard had been cleared of all relics — as much as any graveyard can be cleared — it was no longer holy land, just another piece of real estate. Congregation Emanuel handed it over to the Broadway Improvement and Management Company to sell. Within a year, in August 1924, after some legal bickering about \$2000 in unpaid taxes,⁶ the Water Commissioners of the city of Denver bought the property for \$40,000. Their plans for the use of the land did not materialize until the 1905s when Reservoir #3, the western reservoir, was built and Josephine Street was cut through from 9th to 11th Avenues.

When the Water Commissioners bought the Jewish graveyard, the land had shrunk from 10 acres to 8.7 acres. This was not due to a legal transaction in 1894 when the Jews gave a right-of-way to the Citizen's Water Company for pipes to run from their reservoir downhill to the west for the greening of the new city park, (now Cheesman Park). No land was deeded.

In 1916, however, 1.26 acres of land changed hands. The Denver Union Water Company installed a centrifugal pump to distribute water from its reservoirs (one built in 1888, one in 1906). The installation of the pump cost \$56,159.85, including the purchase for \$5000 of 1.26 acres of land from Congregation Emanuel. This land was on the eastern edge of the Jewish property on which no burials had ever been made nor lots sold. The land measured 83 feet, more or less, by 660 feet (north and south). The 83 feet extended from where Columbine Street would be (if it had been cut through) to the eastern edge of the 1888 reservoir.⁷

So, in 1916, the Water Company paid \$5000 for 1.26 acres of land, and the

Board of Water Commissioners in 1924 paid \$40,000 for 8.7 acres of land. This rise in land values on Capitol Hill, from \$1.25 an acre in 1872 to \$4500 an acre in 1924, has continued ever since.

On the surface of the land east of the Botanic Gardens nothing remains of the Jewish cemetery. But any time excavations are made, relics are brought up. In January 1976, for example, the city installed a sprinkling system along the east side of the parking lot. After a backhoe had pulled up dirt for the trench, a curious passerby picked up the metal hinge from a child's coffin. Perhaps this child had been buried in the special children's graveyard added in 1894 to the south end of the Jewish cemetery, where, in 1902, two unknown children had been buried in the same grave.



Children's Garden Replaces Cemetery

The Pest House⁸

South of the Jewish cemetery, on a site that today would probably be at the south end of the parking lot between York and Josephine Streets, once stood a shack that had a historical connection equally as mournful, and more horrifying, than a graveyard. This was the pest house, the Denver City pest house. Most towns of early Colorado had a pest house, and Denver's was as shabby as that of the smallest town. It, like all pest houses, was situated far out of town, an isolation hut in which people with the dread disease of smallpox were incarcerated, to live or die, often unattended.

As early as 1860, a Denver doctor insisted that the town had to assume responsibility for caring for and isolating smallpox cases, especially because of the increase of virulence due to the altitude. Where the early pest house was is unknown, but by 1881 it was south of the Jewish cemetery on the hill. On April 3 of that year *The Rocky Mountain News* ran a long story about a young man named Albert Shaw, who, riding into Denver on the Kansas Pacific railroad, broke out with smallpox. A doctor, who could do nothing to stop the disease, took him to the mayor, whose duty it was to protect his constituents. The mayor quickly assembled some supplies, including water for drinking and washing, then tried to find some brave or already pock-marked wagon driver who would take the man to the pest house. He finally found one who would drive the two miles for \$10.00.

On the brow of the hill, the driver deposited young Shaw and the supplies before

a two-room house painted light cream with a couple of windows stuffed with straw and rags. Inside was a stove, a pallet, and a table for medicine. The attached caboose, furnished with a pallet, a cooking stove, and a few utensils, housed the attendant, an old gray-haired man of 50.

Whether or not Shaw survived this ordeal is not known, but the next year the pest house "was banked up and fitted for occupancy" and a nurse hired at \$4 a day, when needed. In 1884, the City Council decided to build a new pest house, awarding a contract for \$1000 plus \$200 for lattice work. (Lattice work was not for decoration only; it usually sheltered the path to the outdoor privy.)

By March the new building was erected, but the Jewish community complained that it encroached ten or twelve feet on its property. The *News* reporter could not understand why it had not been built on the old site, nor why the Council did not burn the old shed. "Council wanted to keep it for some unknown purpose," he presumed. In October 1884, John R. Raverdy, vicar-general of the Roman Catholics of Colorado, joined Mr. Solomon of the Hebrew Association to protest the location as too near their "Cities of the Dead." The Council held a hearing at which one Councilman asked, "As a matter of fact, how far can contagion spread?" Another said the whole objection was some real estate scheme; another "moved to place the pest house in the center of the southeast 10 acre lot owned by the city at a distance of not less than 166 feet from its present location." This solution, however, went for naught because not enough council members were present to vote on it.



Tombstone in Jewish Cemetery

Pest House at Sand Creek

The city had to have a pest house, and Dr. H. K. Steele, the city health official, could not wait around for the location dispute to end. In 1885, he erected two small buildings near Sand Creek, seven miles northeast of Denver City Hall and three miles beyond the city limits. Later, if no smallpox victims were in residence, Dr. Steele sent diphtheria, scarlet fever, and measles patients out there. When Dr. Henry Sewall came to Denver in 1891 he found that by the time a child with measles had been driven out to Sand Creek, the child had contracted pneumonia.

Eventually the pest house near the cemeteries was burned, but not until after November 10, 1886, when *The Denver Times* ran an article urging the beautification of the land at the top of the hill. "The site on which stands the pest house comprises 80 acres of land splendidly situated and if proper irrigation be afforded, easily cultivated... Neither tree nor shrub is there," partly because "last spring certain aldermen cut down trees... Mayor Bates says he will plant trees himself," the water for which depends "on the mere digging of a little ditch."⁹

Though the pest house on Capitol Hill was burned, smallpox remained a problem in Denver, as in the world. In 1892 Dr. Steele bought two small houses at 6th and Evans (now Cherokee Street) which evolved into the Steele Hospital for Contagious Diseases. Both it and the Sand Creek houses were used until the first World War. For instance, in 1914, 60 cases of smallpox were treated in Denver and the next year \$2,450 was appropriated for treatment. Today, when vaccination has practically eliminated smallpox from the world, the stigma and misery of the disease has faded into history, as has the pest house on Capitol Hill.

NOTES

1. Prudence Bostwick, who lives north of the Botanic Gardens, remembers the funeral processions coming down Josephine Street, then south to the tree-lined dirt road that led into the cemetery. Myra Hough Thompson, who lived at 1060 Josephine Street, gives a good idea of how few houses were nearby in the early 1900s when she tells how, at night, she and her brother Lawrence looked out of the back window in the second floor of their home to see the lights of the Fairmount streetcars far across the prairie.
2. The men who signed the agreement were Julius Mitchell, Henry Kline and H. Schayer. Mitchell, who ran the "Beehive" grocery store on Magaw Street, being the oldest Jew in Denver, conducted religious services. Schayer's interest in the cemetery was personal, since Feist Schayer was buried there in 1865 and Bob Schayer in 1871.
3. The names of these were: 1865 Feist Schayer; 1867 Adolph Hirsch; 1871 Bob Schayer, Rosa Klein, Solomon Newman; 1872 Harry L. Bloch; 1873 Simon Loeb; 1874 Pauline Cohn, Joel Gottlieb, Herman Davidson, Millie Kirschberg; 1875 Jacob Kirschberg, Simon Schuler.
4. This map is dated May 23, 1874, and appears in Book 2, Page 58, of the *Book of Maps* in the office of the County Clerk and Recorder of Denver.
5. Halaas, D. F. 1976. *Fairmount and Historic Colorado*. Denver, Fairmount Cemetery Association.
6. This was the East Denver Park Special Tax assessed January 26, 1913, to pay for the building of City Park Esplanade. Bishop Tihen of the Roman Catholic church also objected to this tax. Congregation Emanuel refused to pay the tax until after the case of City vs. Tihen had been settled.
7. The legal description of the land sold in 1916 reads "1.26 acres, more or less." The words "more or less" may account for the discrepancy of .04 acres between the original 10 acres and the sum of 1.26 plus 8.7 acres sold by the Jews. The original 10 acre plot was square, 10 chains, or 660 feet, each side.
8. Information about the pest house comes from two sources: first, newspaper articles located through the card index at the Western History Department of the Denver Public Library; and second, Mrs. Beverly Collins, Public Information Officer for Denver Health and Hospitals. Her files and memory are equally helpful.
9. This mention of a ditch is most interesting. So there was water on the hill before 1888 when the first reservoir was built! Some old timers remember a small stream running through the site of 909 York Street, flowing from the southeast; they also remember that part of the land was marshy. Some even theorize that a buffalo wallow was there.

These memories of moisture on the hill were corroborated by F. H. Chen and the Wright-McLaughlin Water Engineers, who studied the geology before they started working on the Botanic Gardens. The bed rock is clay, bentonite clay, which shifts when it is wet. An ancient stream left signs in the bedrock, like a dry gulch, and there are water carrying lenses. On top of the clay is Cherry Creek sandstone, also a water carrier. Alluvial gravel found here indicates either that Cherry Creek lowered its bed or the hill was thrust up.

Because of the marshy condition, some time before the 9th Avenue houses were built tons of fill were dumped there. To support some of the houses, long piles had to be driven. Engineer Chen, investigating the sinking of 909 York Street, drove test cores, and at a depth of 14 feet struck a coffin. In another place a coffin was found that had shifted to an upright position, probably due to the movement of the wet bentonite clay. So the memories of old timers of a creek and a marsh have a scientific explanation.

Innovations in Landscape Design

Editors' Note: The article which follows is an abstract of a panel discussion on innovations in plantings, held at a luncheon meeting of the Rocky Mountain Center on Environment in May, 1977, with the additional recounting of some of the author's experiences.

Jake Frankhauser

The water restrictions of this past summer have given us all a chance to observe how well our lawns and gardens have been able to withstand a sub-normal amount of water. The question then is, did we use our water efficiently and did our lawns and gardens survive? If they didn't, don't be so quick to blame a lack of water. Rather look at how your lawns and gardens were built and at your watering practices to see if there could be some improvement. The panel discussion held on May 16 at the onset of the water restrictions was to explore innovations, suggestions, and alternatives to help you to solve some of your future problems.

Start with the basics. If your lawn or garden does not readily accept water, or if it is using water inefficiently, do a quick analysis of the area. You should:

1. Identify problem areas — slopes/soil/exposure
2. Identify and evaluate water supply — main service/enough hose bibs/adequate pressure/adequate distribution
3. Identify techniques to solve problems.

The basic element of any landscape is the grading and is usually one of the first things the landscape architect considers. If the grade is too steep or too flat, corrective measures become an element of the design solution. Since water will not absorb as rapidly on steep slopes as on flatter slopes, terracing may be the answer. Alternatives of ground cover with mulch will also work to reduce the wasted run off water. Terracing will solve a majority of the problems of steep front lawns often found on older homes in Denver.

Section A

If you are planning a new home you have the opportunity and challenge to shape your landscape to fit your needs. You may include in some portion of your landscape a relatively flat area for the lawn and the remainder of the steeper land for ornamental plantings. Knowing that shrubs and ground covers require less water than

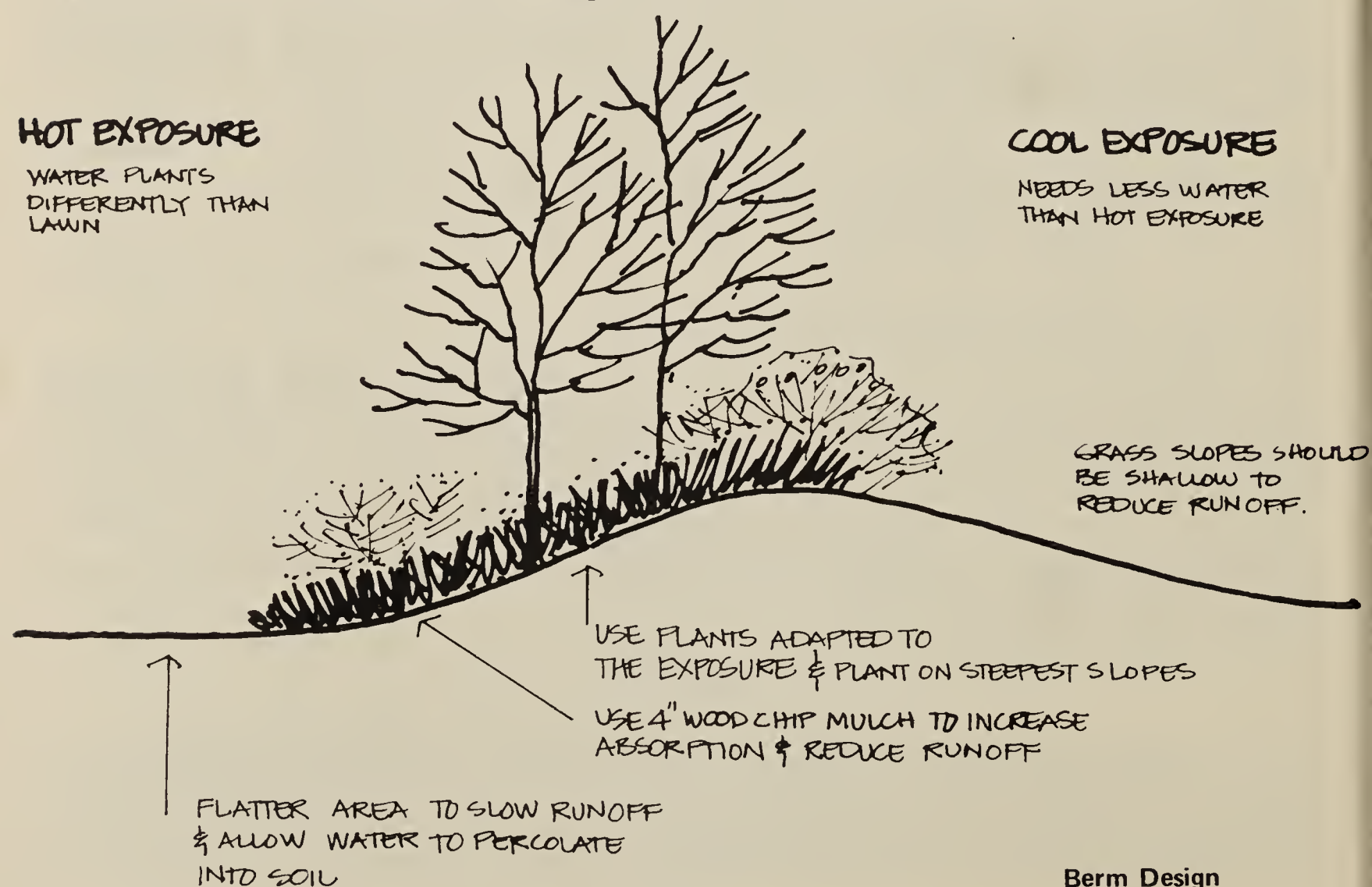
lawns and that water retentive mulches can be used on steeper grades to reduce weeding and erosion, why not reduce the area of lawn?

Naturalistic earth mounds and berms are an effective design tool; however, they are water users if not properly designed and planted. Runoff on a 12% slope is twice as fast as on a 2% slope. So if berms are to be fairly steep, plant them with ornamentals, use wood chip mulch, and water them differently than the lawn. When selecting plants remember the exposure so the shady side is treated differently than the hot, exposed side.

Section B

If in your lawn you have dry, compacted spots or difficult areas to water, maybe the answer would be to change the area from lawn to plantings. This is especially true of the curb strip and a planting that is particularly adapted to this problem area is buffalo grass which will be discussed later. (Note: Check with city codes before adding any raised planters in the curb strip.)

Several other design techniques that reduce lawn area or solve difficult problems were discussed by Landscape Architect Alan Rollinger. The narrow strip at sides of houses could be converted to passage gardens where pavers or stepping stones provide the path and plantings and ground covers reduce the maintenance and water problem. Wooden decks or patios that extend from the house into the garden are attractive ways to reduce the lawn area and provide additional entertaining space. A very interesting water conservation technique Rollinger showed was a dry stream bed landscape treatment. By shaping the ground to resemble a stream, laying plastic, and covering with gravel and small outcroppings of rock, he created a moist area under the stream bed whereby roots of streamside plantings could seek a cool and damp environment. The



Berm Design

technique might also work to mask a wet spot or to help drain a very flat slope.

The illusion of water created by the streamside plantings and rock work can be a most effective way to reduce lawn area and conserve moisture.

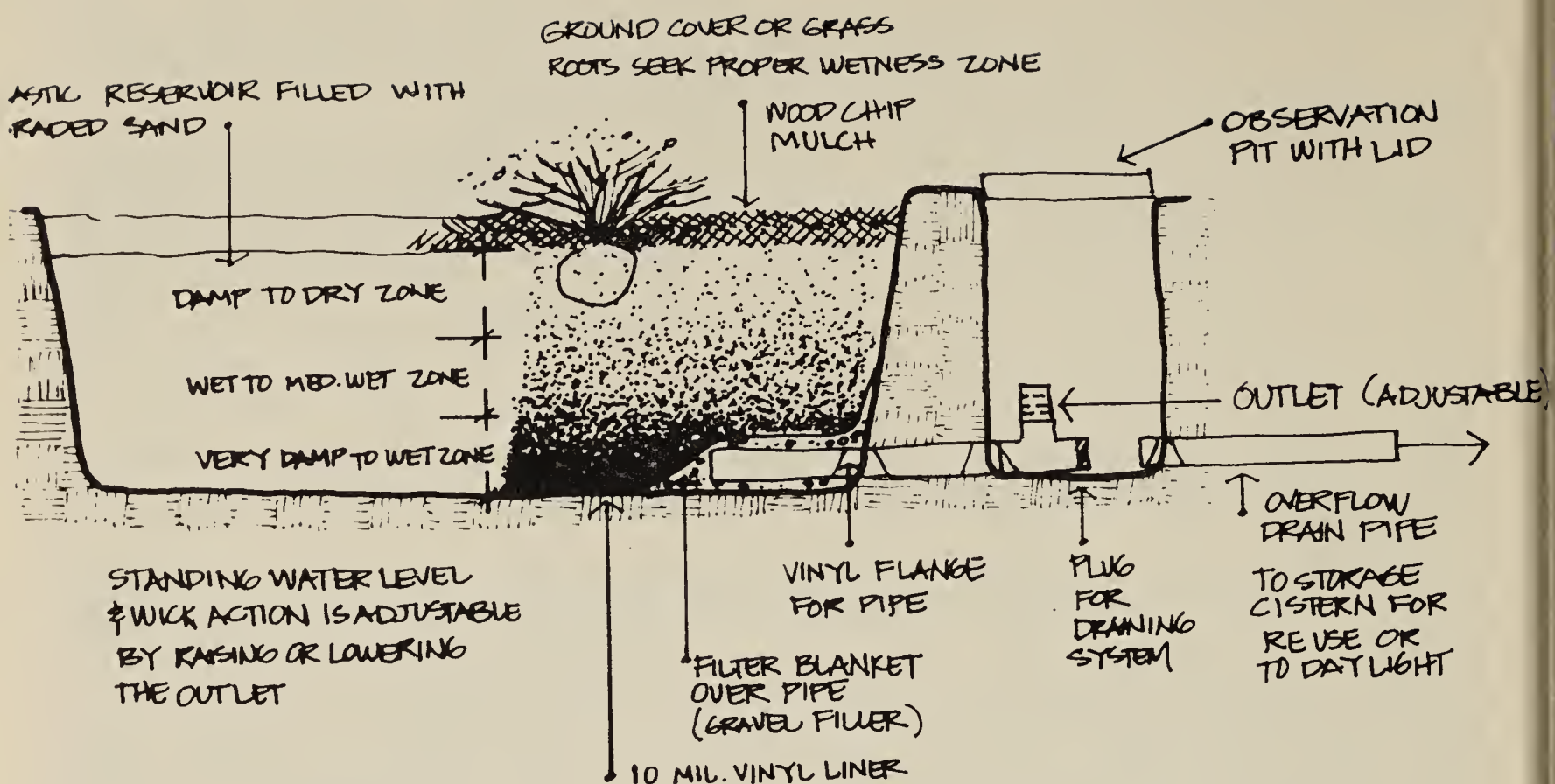
For those who wish to use mulch for large planting areas, please review Dr. Feucht's gardening tips in the October 1977 *Green Thumb Newsletter* about the use of plastic. I have found that if you use new wood chips 4" deep without plastic they will hold soil and water on very steep grades and reduce the amount of weeding. This technique assumes that you have used weed-free soil additives and have done a good job of removing weeds from the bed when it was tilled. This method allows you to water one-third the normal amount thus reducing weed growth, cutting, much watering time, and saving precious water. Remember to add ammonium sulfate to the surface of the soil before placing the wood chips to help feed the organisms that break up the wood fiber.

If you must use a weed control device you might experiment with "Weed-Check", a fiberglass blanket manufactured by Brighton By-Products, Box 23, New Brighton, PA 15066 or Mirafi 140 manufactured by Celanese Fibers Industries and supplied locally by Boman Construction Supply. Both products have the ability to hold rough wood chips, crushed or dolomite rock on steeper slopes than plastic. Since they are porous, they allow the soil to breathe and water to penetrate to the root zone. Mirafi 140 has not been extensively tested for weed control; however, it is a soil retention blanket and is worth the experiment on home applications. Since Mirafi is a filter blanket, it can be used to line a gravel trench to drain wet areas and it will not silt up the gravel as in the old French drain. It also can be used in lieu of drain tile.

The Purr-Wick System

Another interesting technique to conserve water in gardens or lawns is the PURR-WICK system. PURR-WICK stands for Plastic Under-Root Reservoir System with a Wick Action. It works on the same principle as an oil lamp; the sand serves as a wick from the plastic lined reservoir of water and nutrient. If you've ever dug into the sand at a beach you will observe that there is dry sand on the surface, but as you dig deeper, the sand becomes progressively damp until you hit the water level. With this system you simply adjust the level of water standing in the reservoir to allow water to wick up to the plants. This has the advantage of trapping all of the natural rain fall you want to use, re-using the water if necessary, or reducing water loss which leaches out of the planting area. This system has application to ornamental plantings, flower beds, or small lawn areas. The system was developed for golf course greens and so it is adaptable to a 6000 square foot lawn area with a change in elevation. I have used it on a roof top garden in Denver where only 8" of sand was used as the growing medium.

Since no water that is needed leaves the system, *all* of the natural rainfall that occurs can be utilized. In the roof garden we are using day lilies, variegated ribbon grass, Russian olive, junipers, aspen, sedum, *Euonymus coloratus* [*E. fortunea* forma *colorata* Rehd.], so the plants' moisture requirement fairly well matches the natural supply. There are observation pits located throughout the system so that the moisture level can be observed, and water can be added by the flood irrigation technique. The shallow depth of 8" was an experiment since the loading of a roof top landscape had to be kept under 100 pounds per square foot. When plantings are done on the ground the normal depth of sand would be 18" to 24".



PURR-WICK Concept

If you ever play golf at the Pinery Country Club in Parker, you will play on PURR-WICK greens.

In a recent article in *Weeds, Trees and Turf Magazine* (August 1977, available at the Botanic Gardens Library) a California golf course superintendent claims that in five months of testing PURR-WICK he saved an average of 42% or 57 gallons of water a day per 1000 square feet of green. On an 18-hole golf course, that could project to a potential savings of 4 million gallons of water per year for the greens alone.

Section C

Again the whole purpose of alternatives is to use more efficiently the water that we have. Larry Watson used this premise when he discussed selection and supply of low-water-using plants.

Selection of plants is directly related to supply of water. It is doubtful that anyone would want to revert to a strictly native landscape. After all, a little sagebrush or rabbit brush would go a long way. Plants, even natives, cannot be planted, watered to establish, and then left to the elements. So Larry likes to think of selecting plantings that can be managed with less water.

Selection of plants which do well with minimal water and care is often difficult especially when reference books disagree or list only a handful of "safe" plants. In our area there is no substitute for observation of how well plantings do in certain exposures. And there is no substitute for proper management such as soil preparation, mulch, checking soil moisture throughout the growing season, and winter watering. Careful research of available reference books and discussions with your nurseryman or landscape consultant will help you select the best plants for your needs. In your

reading you will undoubtedly come across a plant that seems to fit your needs perfectly. However, when you go to the nursery to pick it out, it isn't there. Availability of drought tolerant plants has faltered in the local nursery industry due primarily to non-acceptance. Like any great revelation spurred by approaching catastrophe, the native plant was looked upon as the solution when our water was curtailed. Similar to the small car boom and subsequent return to the gas guzzler after the oil embargo, so goes the native plant market. Some plants put out little seed in a drought period, a very natural reaction, while others take several years to propagate and grow to landscape size material. Nurseries are hard pressed to speculate on the demand for these plants. Thus, when the water is shut off there is a rush for the alternatives and they are not there. The alternative is to plan ahead or at least design your landscape to receive the plants when they are ready and place your order now. There is absolutely nothing wrong with laying out the garden, preparing the soil, doing any necessary construction, mulching the beds, and filling in the plantings a year or two later when your favorite is ready.

Collected native plants that appear in the natural setting as compact spreading attractive and neat plants can become a nuisance when transplanted to good garden soil and watered regularly. So again, observation of these plants under both conditions will help you decide if you want or have the room for the "monster."

Buffalo Grass Lawns

A recent breakthrough in conserving water has been the ability to establish buffalo grass lawns. The persons who have tried it and succeeded could almost be labeled "cultists" or true believers. Others who have not given it a fair chance are its worst enemies. I have tried to establish it according to seed companies' recommendations and in numerous experimental ways and have had marginal to moderate success. However, Gary Powell has been the successful pioneer in establishing this seed on commercial and residential projects and his method has become the norm because it truly works.

The landscape "underground" who praise this alternative are akin to the solar energy advocates who have found research money going elsewhere. Maybe some day a truly drought tolerant bluegrass strain will be developed; however, buffalo grass is a native of our high plains soil and is already adapted to the alkaline and heavy soil we all know and love.

Calculations made by Powell from actual field-tested plots including his own yard indicate that:

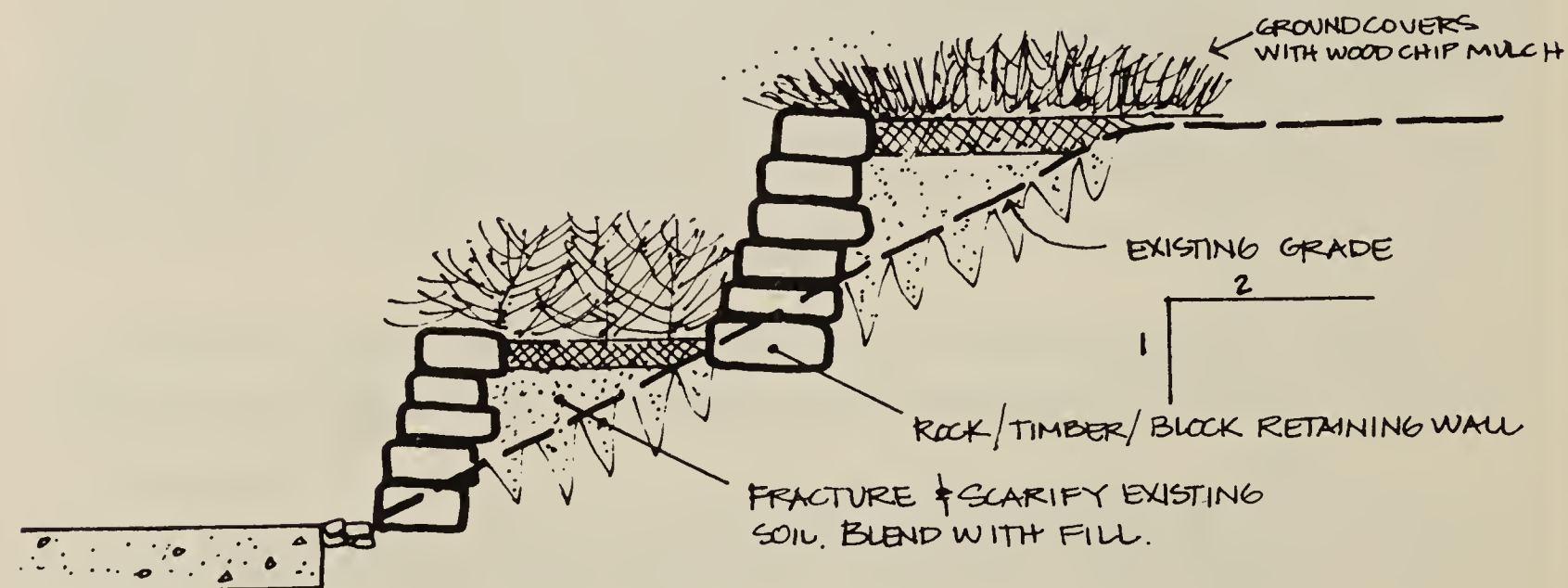
1. Buffalo grass needs about one seventh ($1/7$) the amount of water as blue grass.
2. Is as easy to establish from seed.
3. Is about twice as expensive as bluegrass to seed but costs about 25% less than sod.

Fertilizer applied to established buffalo grass does not improve or darken the color, but does increase the mowing and the water requirement. One thing that is essential to establishment is soil preparation, and the deeper the hard pan soil is fractured, the better color and vigor of the lawn.

Buffalo grass cannot be overseeded into an existing lawn so the existing vegetation must be stripped or removed prior to soil preparation. For soil preparation, use mountain peat or sawdust or a weed-free organic material at rate of 3 cubic yards/1000 square feet of area and 10 pounds/1000 square feet of superphosphate to

promote root growth and seed production. Rip the soil to a depth of 8", till the organic material and superphosphate to at least 6" deep. Level the soil to proper grade in preparation to seed. Use buffalo grass seed which has been treated to speed germination. "Sharp's Improved" buffalo grass seed is recommended and it has a distinctive blue/green dye to help identify it. You should select a seed with an 85% germination rate and it should be 85% pure. Spread the seed at the rate of 7 pounds per 1000 square feet with a cyclone or drop spreader sowing one half in one direction, the other half at 90 degrees to the first pattern. Carefully rake to cover (1/4" deep max.) the seed and roll with a 100 pound roller to give the seed a firm seed bed. Uniformly top dress the seed with 1/4" of peat (1 cubic yard per 1300 square feet). Roll and keep *uniformly damp* for 10-14 days or until seedlings are 1" to 1 1/2" tall. Withhold water for one month then soak the lawn by applying 1" to 1 1/2" of water in a single application during the months of June, July and August. The time to seed buffalo grass is very important. It is a warm season grass so it should not be seeded before May 15 or after September 1. If the weather is unseasonable, make sure soil temperature is above 65° for complete germination. There have been experiments where it has been seeded as late as September 15 with good results, however stick to the formula for best results. Seed placed too early will have a tendency to mold or rot before hot weather arrives to start the germination. Since this seed thrives in a hot dry location it will not perform as well on the north side or in dense shade.

Seed is in such demand that it will pay to order some now for next summer. Why not try it on the curb strip rather than gravel mulch and see if you are a believer?



Terrace Concept

• TYPICAL DENVER FRONT LAWN •

Focus on

Citrus limon Burm.

in the Boettcher Memorial Conservatory

Peg Hayward

Rutaceae is a large family including about 140 genera and 1500 species, mostly trees or shrubs. It occurs chiefly in tropical and subtropical regions, but extends into warm temperate areas. Distinguishing characteristics of this family are translucent dots on the leaves which are clearly evident when held up to light, and the presence of glands that secrete aromatic oils.

Eight of the ten species in the genus *Citrus* produce some of the world's most important fruits. *Citrus limon* Burm., lemon, leads all the acid fruit bearing citrus species in commercial importance. The origin of the lemon is obscure; possibly it is a derivative of the citron. Its native home may have been southern China and adjacent parts of Upper Burma, from which areas its culture spread into India and westward. It is recorded that by 1150 A.D. it was growing in Spain, where it was introduced by the Arabs. The Crusaders apparently had a part in its introduction into western Europe. Columbus on his second voyage to the New World in 1493 brought lemon seeds and probably fruit with him to Haiti.

The lemon tree is a small, openly branched, thorny tree up to 20 feet high. The young evergreen foliage is reddish at first but later assumes a pleasing waxy green color. The lemon has narrowly winged leaf stalks. Its aromatic leaves are pointed and more or less serrate. The tree bears large, fragrant, star-shaped flowers. Petals are white on top and purple-tinged underneath. The flowers are either solitary or in small clusters occurring in the axils of the leaves. Flowers of the lemon differ from other *Citrus* species in having more than four times as many stamens as petals and in having flowers of two kinds, some with functioning stamens and ovaries and others with fertile stamens but abortive ovaries.

The fruit of the lemon has a white, spongy rind and a yellow skin dotted with tiny glands which look like pores. Inside the fruit are eight to 12 sections filled with a valuable citric-acid juice high in vitamins A, B, and C. The spongy part of the rind contains pectin and the colored skin contains bitter lemon oil, used for flavoring and per-

fume. The lemon tree blooms and produces fruit almost continuously in the right climate and under proper care, bearing fruit and flowers at the same time. However, most fruit is produced in winter and in early summer. The fruit is picked while it is still green and kept in storage until it ripens. In storage, the rind becomes thinner and tougher and turns yellow. When picking the fruit care should be taken so that it is not bruised or the peel broken with fingernail or punctured by any of the tree's spines; otherwise a mold will form when the fruit is stored.

Considerable numbers of lemon vari-

eties have been propagated and introduced. Some of these are grown to supply lemons for the market; others are of value as ornamentals, and some find a place in a home fruit garden. In conservatories and even in residences the trees are often grown in large flower pots or tubs for ornament.

Several other species of *Citrus* may be seen in the Boettcher Memorial Conservatory collection besides *Citrus limon*, including: *Citrus aurantifolia* Swingle, lime, *C. aurantium* Linn., sour orange, *C. paradisi* Macf., grapefruit, *C. mitis* Blanco, dwarf calamondin, *C. reticulata* Blanco, tangerine.

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Citrus limon Burm.

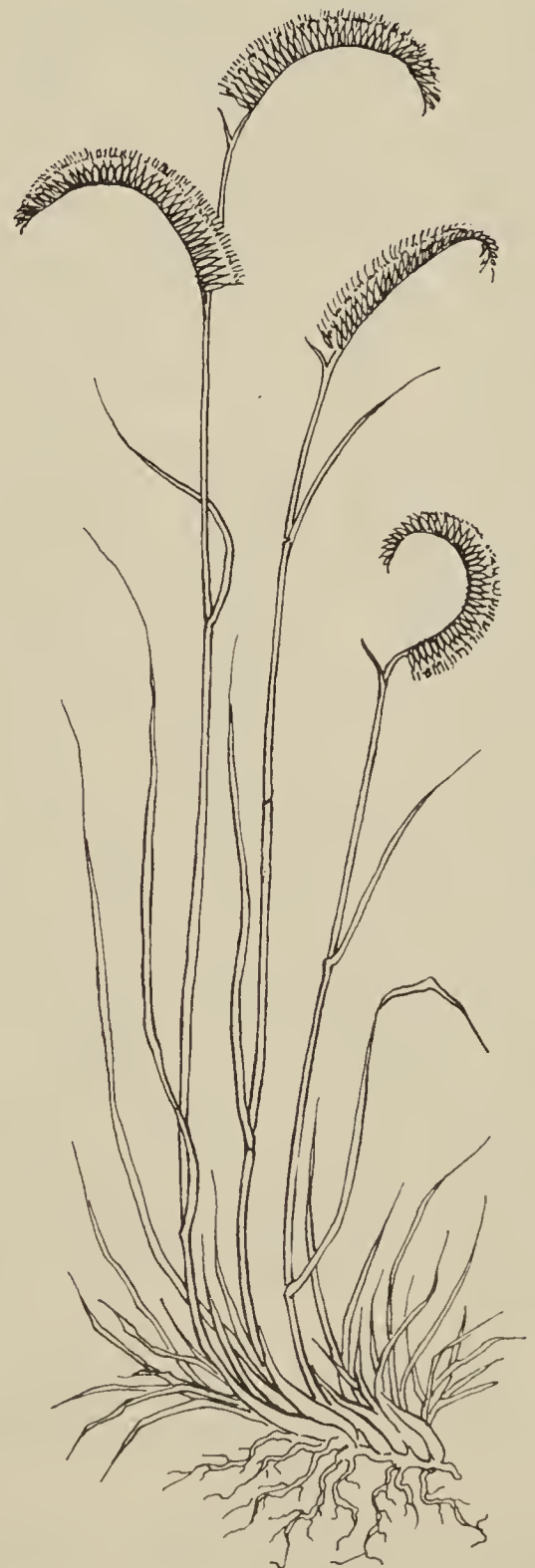
Native Grasses of the Plains

Conservation Center

Helen Marsh Zeiner

The Plains Conservation Center is a 2000 acre tract in Arapahoe County, on East Quincy Avenue south of Buckley Field. It is owned and operated by the West Arapahoe Conservation District and the Plains Conservation Center Association and is to be preserved as a block of natural prairie. It is being developed in part as a center for study and recreation, a place to foster appreciation of the wise use and conservation of semi-arid land. When the land was acquired about 1950, it was badly overgrazed and eroded. Now it is returning to its natural state, mixed grass prairie.

The mixed grass prairie is so named because it is made up of a mixture of mid and short grasses. All of the grasslands of eastern Colorado belong to the mixed grass prairie, although most of the area is at present in the short grass disclimax. This is because the short grasses were damaged less than the mid grasses by over-grazing, and as a result they have generally replaced the mid grasses. For a long time it was believed that this short grass condition was a climax for the Great Plains, but it is now well understood that this is actually a mixed grass prairie, and the presence of the short grass indicates only over-grazing. Evidence to support this view is the fact that in places which have been protected from grazing for many years, the mid grasses are present and we have



Bouteloua gracilis H.B.K.

the composition of a mixed prairie. The old family cemetery, fenced to keep out the stock, is often a good place to see this. Also, in short grass areas fenced more recently, the mid grasses have returned or are returning. This is true at the Plains Conservation Center. Other evidence that Great Plains was a mixed grass prairie is found in reports and pictures by early travelers.

The short grass cover in eastern Colorado is primarily *Bouteloua gracilis* (H.B.K.) Lag. (grama grass) and *Buchloe dactyloides* (Nutt.) Engelm. (buffalo grass). Among the mid grasses we should expect to find *Agropyron smithii* Rydb. (western wheatgrass). *Andropogon scoparius* Michx. (blue stem), *Sporobolus cryptandrus* (Torr.) A. Gray (drop seed), *Stipa comata* Trin. & Rupr. (needle grass), and *Aristida longiseta* Steud. (threeawn). The taller grasses are generally more abundant in swales, bottomlands, and drainages where additional moisture tends to compensate for the pressure of grazing.

In order to determine the grasses present at the Plains Conservation Center, a survey was made during the summers of 1974-1976. Twenty-six species and varieties of grasses were collected in 1974 and 1975. No new species were found in 1976. Unfortunately all of the years of the survey were dry years, with grasses dried and not flowering by late summer. This would seem to explain why late-blooming grasses such as *Andropogon* were not found. Future collections in wet years will undoubtedly add several species to this list of grasses.

GRASSES COLLECTED AT THE PLAINS CENTER

Aegilops cylindrica Host. (Hordeae) —
jointed goatgrass
Agropyron cristatum (L.) Gaertn.
(Hordeae) — crested wheatgrass

Agropyron smithii Rydb. (Hordeae) —
western wheatgrass
Agropyron smithii molle (Scribn. &
Smith) Jones (Hordeae) — western
wheatgrass
Agropyron trachycaulum (Link.) Malte
(Hordeae) — slender wheatgrass
Aristida longiseta Steud. (Agrostideae) —
red threeawn
Bouteloua curtipendula (Michx.) Torr.
(Chlorideae) — side-oats grama
Bouteloua gracilis (H.B.K.) Lag.
(Chlorideae) — blue grama
Buchloe dactyloides (Nutt.) Engelm.
(Chlorideae) — buffalo grass
Bromus japonicus Thunb. (Festuceae) —
Japanese brome
Bromus tectorum L. (Festuceae) — cheat-
grass brome
Elymus canadensis L. (Hordeae) —
Canada wildrye
Festuca ocotflora Walt. (Festuceae) — six-
weeks fescue
Hordeum brachyantherum Nevski
(Hordeae) — meadow barley
Hordeum jubatum L. (Hordeae) — foxtail
barley
Koeleria cristata (L.) Pers. (Aveneae) —
June grass
Oryzopsis hymenoides (Roem. & Schult.)
Riker (Agrostideae) — Indian ricegrass
Panicum capillare L. (Paniceae) —
common witchgrass
Poa pratensis L. (Festuceae) — Kentucky
bluegrass
Poa secunda Presl. (Festuceae) —
Sandberg bluegrass
Schedonnardus paniculatus (Nutt.) Trel.
(Chlorideae) — tumblegrass
Sitanion hystrix (Nutt.) J. G. Smith
(Hordeae) — big squirrel tail
Sporobolus cryptandrus (Torr.) A. Gray
(Agrostideae) — sand dropseed
Stipa comata Trin. & Rupr. (Agrostideae)
— needle and thread
Stipa robusta (Vasey) Scribn. (Agros-
tideae) — sleepygrass
Stipa viridula Trin. (Agrostideae) — green
needlegrass

Specimens of the grasses collected have been deposited in the Kathryn Kalmbach Herbarium of Denver Botanic Gardens and at the Plains Conservation Center.

The author wishes to thank Mr. Evan Obrecht, Manager of the Plains Conservation Center, for his help in making this survey possible.



Stipa viridula Trin.

Librarians To Meet

Denver Botanic Gardens will be host to the Council on Botanical and Horticultural Libraries for its annual meeting on 7 — 10 June 1978. The Council on Botanical and Horticultural Libraries, Inc. (CBHL) is an organization whose purpose is to initiate and improve communication between persons and institutions concerned with the development, maintenance, and use of libraries of botanical and horticultural literature. CBHL encourages and assists in the coordination of activities and programs of mutual interest and benefit. Individual memberships are available to librarians, interested persons from the horticultural and botanical professions, and others. The Council was formally organized at a meeting held in Pittsburgh at the Hunt Botanical Library in April 1970.

The Helen Fowler Library has belonged to this organization since its inception. As institutional representative, the librarian, Solange Gignac, has attended CBHL meetings in Washington, D.C., Toronto, Cleveland, Philadelphia, and Chicago. All previous meetings have been generously programmed and have been educational as well as entertaining.

Already planned for the June meeting is a dinner at which Anne Zwinger will present a talk accompanied by a slide show of tundra plants. This will be followed by a day long trip to Rocky Mountain National Park where our guests may be able to see the plants previously described and shown by Mrs. Zwinger. DBG looks forward to acting as host for this conference.



Gentian Blue

Panayoti Callas

Blue is the problem color in the garden. Most garden flowers come in red, yellow, white, purple, or orange. None of the larger classes of garden flowers such as lilies, roses, dahlias, or the commoner annuals comes in blue at all. Blue is sparsely furnished by a few fleeting iris, an edging or two of ageratum, anemic allyssum, or some mildewed larkspur. Even the lesser known perennials noted for blue, like balloon flower or campanula, always seem to harbour an undertone of purple or lavender. Certainly none of these can begin to compare with gentians for intensity, purity, or variety of blue. One can have gentians in bloom in Colorado from the star gentian of the Alps in April to the dramatic Japanese gentian in November — and every month in between. Why are they so little known or grown?

Most gardeners know gentians either because they have admired our native sorts on the plains or mountains, or else they have noticed pictures of the star and trumpet gentians that so frequently appear on Swiss and German calendars. However lovely our wild gentians, I wish to state here at the start that these are not really suited to growing in the garden. Garden gentians have adapted to man-made conditions slowly, over many generations. Our native cup gentian, for instance, is morphologically almost

identical to the Caucasian gentian — but the latter is an easy, reliable garden plant that can be moved or divided with impunity. It has been selectively bred to do this for the last hundred years. All wild flowers resent disturbance, but none more so than the gentians. All gentians, even the smaller sorts, have unusually large and brittle roots that spread deep and wide into the rocky soils of mountain meadows where they usually grow. To tear them out of their mountain homes and heave them into some dismal corner of the garden is murder. It is especially regrettable when it comes to gentians, for there are so many species that are far showier and easier to grow available to enterprising gardeners.

Colorado Climate Salutary

The greatest obstacle to growing gentians is their mythical reputation for difficulty. This is partly due to the Victorian fad of collecting wild plants to stuff rockeries, only to watch them die. Gentians were invariably the first to respond in this fashion. Although many gentians are among the easiest perennials to grow, demanding less water, cultivation, mulching, fertilizing, pruning, or fussing than roses, for example, many other species are resentful of humid, lowland conditions that prevail over

most of the regions where gentians are commonly grown. This is precisely where our Colorado climate can provide unexpected benefits. Dry winters, intense sun, and low year-around humidity have a salutary effect on many plants that are sensitive to bacterial and fungal attack in humid climates. Gardeners have documented the fact that the lower levels of ultra-violet and cosmic radiation at sea level are responsible for failure with gentians. The plants simply stop growing under muggy conditions while bacteria and fungi proliferate. The magnificent trumpet gentian is especially notorious for sudden die-back and sparse blooming in England and on the eastern and western seaboards of the United States. Several local gardeners have discovered, however, that the gentians in this group are quite reliable here in Colorado, blooming profusely in a variety of sites and soils. They are never subject to fungus spots or sudden collapse since soil micro-organisms that cause these diseases are kept in check by the same sun that coaxes the plants into prodigal bloom.

This is not to say that all gentians can be left to their own devices among the native cactus and yuccas of the plains and be expected to thrive. Most summer gentians can be grown under ordinary perennial border conditions. They will grow and bloom under such conditions with minimal care (gentians in this group move easily and moreover do not need to be continually divided and replanted as do so many garden perennials). For the choicer spring and autumn gentians, it is important to provide a few minimal conditions, including a deep, porous soil that is kept cool and never bone dry. In order to guarantee success with these unique and aristocratic plants, it is worth trying to approximate the following conditions as closely as possible. Since many other choice plants thrive under the same

regimen, a special corner, or "gentian bed", can be set aside with a minimum of initial effort or expense. I will describe my own experiment along these lines which has resulted in remarkable success in growing dozens of species of gentians in Colorado.

Experiment Successful

Select a site with abundant sun, but where it never gets too hot (my bed is located to the east of my house where the wall and a distant tree shade the bed during the hottest part of the day). Either excavate or mound (or both) to give the bed at least a foot or preferably more of the following ingredients: one part sedge-peat, one part coarse sand, and one part native soil. Unless you are blessed with the only garden with true soil in the state, this is absolutely necessary. Since gentians love drainage as much as they love coolness and moisture, give a slight slope to the bed to insure that they will never become sodden from overwatering or torrential rains. If the bed slants away from the sun, so much the better. If the sun's rays strike the surface of the bed at an acute angle, the soil will heat up less and bacteria will be kept even more in control. If the area to be planted is large be sure to include a number of large rocks to use as stepping stones in order not to pack the soil. A few rocks, buried solidly and watered in can be pleasing in themselves if carefully placed. They are an excellent means of providing tiny microclimates: a moodier species of gentian placed near a rock will often thrive, where it might languish on bare soil. It is useful to top dress the entire bed with a half inch or so of pea gravel. This further reflects the sun's heat and lends a neat appearance to the bed (gentians often grow in similar scree-like sites in nature, their glossy, deep-green leaves blending well with

gray stones). A gravel mulch makes pulling weeds easy, discourages most weed seeds from growing, and minimizes watering. If the bed is properly situated, it will need a good drenching only twice a week in the growing season. With more sun, heat, and invading tree roots the bed will naturally need to be watered more. Watering should be stopped altogether in the fall since gentians appreciate dry winter conditions.

Larger gentians should have at least a foot square to themselves. Since their roots quest deeply, and their stems do not elongate until late in the season, even the large species don't mind being interplanted with tiny bulbs such as crocus and tulips or *Iris reticulata* Bieb., or with restrained ground covers. I have found that all gentians, including the tinier spring-blooming sorts, enjoy growing with the mat-forming, dwarf *Dianthus* species (like *D. neglectus* Loisel., *D. glacialis* Haenke or *D. Alpinus* L.). Other companion plants might include 'Alleghany Bluets' (*Houstonia serpyllifolia* Michx.), low growing *Primulas* (*P. minima* L., *P. juliae* Kusn., *P. clarkei* G. Watt., *P. auricula*

L.), saxifrage, and especially the more dwarf *Globularias* (*G. bellidifolia* Ten., *G. cordifolia* L. v. *nana*, *G. repens* Lam.).

Avoid "Decumbens"

Many American sources for both gentians and their companion plants can be found among nurseries that advertise in the *Journal of the American Rock Garden Society*. Would-be gentian growers should be warned of one great frustration in ordering gentians from nurseries or growing them from seed. Most gentians are choice garden plants, but there is a welter of species that are usually referred to as "decumbens" gentians. These are large, leafy plants named for the most widespread species in the group. They all produce their large stalks with tiny blue flowers in midsummer, and though a few may have a place in an out of the way corner of a garden, these should definitely not be planted with the choicer spring and autumn species. They seed wildly, and every seed seems to germinate and immediately grow to alarming propor-



Gentiana sino-ornata Balf.

tions. Even a week in the spring is sufficient time for seedlings of the decumbens group to choke out an entire bed. The plants must be remarkable regenerators, since the Chinese have harvested them by the ton for medicinal purposes over the millenia without making a dent in the wild populations in the western Chinese Alps. Fortunately there are four book-length studies of gentians written specifically for gardeners (listed in the references): all four books strive at great lengths to identify gentians of this group. Nurserymen are not always so careful. Several large-scale mail-order nurseries are beginning to offer gentians of this group since they are so easy to raise and grow. They don't always warn their customers that these are not the gentians of the calendar but of the medicine chest. Even more frustrating are the gardeners who sometimes contribute seed of decumbens gentians labeled as a more desirable species to the seed exchange of one of the many plant societies that offer gentian seed. Every serious gentian grower has watched a seed flat labeled "*Gentiana pyrenaica* L." or some other impossibly choice species sprout hundreds of cabbagey decumbens seedlings. Fortunately, these are recognizable at their very earliest stages of growth, and can be dealt with summarily.

So many species of plants have at one time or another been dumped into the catch-all genus *Gentiana* that some botanists are beginning to examine the old genus more carefully and re-assign most of the thousand or so species from all corners of the northern and southern hemispheres to other genera. In the process some have banished *Gentiana*, in the narrow sense, from North America altogether. The few species left in the group are Eurasian, gigantic sorts resembling our native monument plant (*Frasera speciosa* Dougl.) in stature; most ignominiously, they are yellow.

For gardeners and wild flower lovers alike, gentians will always remain blue in common parlance, and for the present, nurseries and many botanical and horticultural writings will adhere to time-honored usage and still refer to all groups of pleated Gentianaceae as *Gentiana*. It should be remembered, however, that most of the familiar gentians will not appear as *Gentiana* in the future; indeed, soon none of the species enumerated below will appear with this generic name. For the time being it probably is sensible to keep the old name as well as learning the new.

What species of gentians will grow in Colorado? Hundreds may sometime find their way into our gardens, but at present there are a few groups that are especially worthwhile to grow. These can be conveniently grouped as to season of bloom.

Spring Gentians

There are two main groups of spring gentians. Both groups occur in Europe for the most part, a few of the star gentians extend across northern Asia almost to the Pacific coast. The star gentians include *Gentiana verna* L. (the most common example), *G. brachyphylla* Vill., *G. bavarica* L., and a number of other small alpine species that form mats of tiny, evergreen leaves usually less than half an inch long. Most of the members of this group send up numerous short stems with a comparatively huge flower, often two inches across, open wide on each stem. They bloom in April and early May for the most part, and the typical star gentian is of the deepest azure or ultra-marine in color. A yellow-flowered form has recently been introduced to cultivation from Russia. These are unquestionably the most difficult of choice gentians to grow well. They are reluctant to bloom and short-lived in wet, lowland climates — but I have found them prodigal of



Gentiana acaulis L.

bloom and reliably perennial under the conditions described above. They are best propagated from seed (allowed to freeze and thaw repeatedly outside during the winter), or from cuttings taken from the short underground stolons which constantly extend the clump.

The trumpet gentians constitute the other group of spring gentians. Almost every mountain from the Pyrenees to the Balkans has its own species, variety, or local hybrid of trumpet gentian. These are unquestionably the most spectacular members of the genus, and the Alpine Garden Society of England has selected one of this group as the emblem of the club. All trumpet gentians are sometimes lumped under the name *Gentiana acaulis* L. I feel however that the members of this group that I have grown are so distinct they must deserve specific recognition. *G. acaulis* is typical of the group with oval, glossy-green leaves two or three inches in length forming dense prostrate mats (all spring gentians are evergreen, decorative at all times) sending out short stems with a single, immense flower at the end. The flowers in the group may vary from two inches long in the smallest, to almost four inches long and two inches wide in the giants of the group. The flowers are always of the

most intense blue, from paler navy blue shades to virulent cobalt and midnight blues. The throat is often flecked green and white in *G. clusii* Perr. & Song., *G. kochiana* Perr. & Song. and *G. excisa* Presl. (the largest flowered sorts). *G. dinarica* Beck. is darker than these, with longer stems and flowers with tapering, pointed petals. This is among the easiest of the group to grow. *G. angustifolia* Vill. is unique in the group, producing very long, leafy stems with many narrow leaves less than a half inch wide, with very long stems to the flowers. *G. alpina* Vill. is the tiniest, with leaves barely an inch long and stemless flowers. These are easier to grow for the most part than the star gentians, but deserve to be set aside in a special gentian bed. They can be easily divided in late May or early June as their flowers fade. Division at other times can result in losses.

Summer Gentians

In Colorado, native gentians mean high summer and the approach of fall. It comes as no surprise that the bulk of the family blooms at this time in the garden as well. There are hundreds of choice gentians that may some day be available to gardeners to provide drifts of the purest blue in the summer, but at present the most frequently grown

gentians blooming in the summer months are the Caucasian species. These are usually represented by forms of *Gentiana septemfida* Pall., a polymorphic plant that resembles our native cup gentian so closely in most of its forms that the two are usually confused in England where they are often grown. (The cup gentian presents some interesting nomenclatural problems; the name *Gentiana parryi* Engelm. is apparently invalid. It has appeared as *Gentiana calycosa* Griseb. in recent treatments, but the true, Pacific northwestern *G. calycosa* is a very different plant, usually growing in water, with a single wide open bell on each stalk, and foliage of a more succulent texture.

Caucasian gentians will grow in ordinary garden soils, but are choice plants for the gentian bed as well (they are not violent seeders like the decumbens sorts). The typical forms produce ten to fourteen inch stems with many glossy-green, oval, opposite leaves, the stems splaying out from a central crown to produce an elegant cartwheel of flowers. Dwarf or upright growing forms are sometimes listed as separate species; these extend the blooming season from June to September and offer an even broader range of color: *G. freyniana* Borum., *G. lagodechiana* Kusn. and *G. x hascombensis*. There is even a yellow species, *G. gelida* Bieb., in this group that recently was introduced to cultivation. The entire group can be propagated by divisions, cuttings or pre-flowering shoots, and seed. They should be grown in every Colorado garden.

There are many other choice summer blooming gentians; however I have not had enough experience with these to speak authoritatively. The decumbens sorts bloom at this time, as do the bottle-gentians of eastern America. However, none of these can begin to compare with the Caucasian gentians for ease of culture or showy bloom.

Autumn Gentians

The best known fall blooming gentians are the so-called "Himalayan Gentians." These are so popular in England and Scotland that they are used as bedding plants and sold as cut flowers. They are not as easy to grow in our dry climate as other gentians, but with careful attention to watering (they will not endure complete drying of their comparatively shallow roots) I have found that a number of Himalayan species and hybrids will grow and bloom well here. The conditions described above suit them perfectly — however they prefer a little more shade than other gentians in our climate, and are the only group of well-known gentians to demand emphatically soils with an acid reaction. If your water is alkaline, do not even try to grow these.

The best known members of the group are the midnight blue *Gentiana sino-ornata* Balf. and the 'Cambridge Blue' *Gentiana farreri* Balf. Both these and others in the group produce many twining stems beset with short, grassy leaves from a central crown that form a mound of buds by late summer. The first flowers open in August, but they continue to bloom until November through the heaviest frosts. All gentians in this group are best divided every few years in the spring, because they exhaust their soil quickly, and some are enthusiastic stem rooters. A single clump of *Gentiana sino-ornata* will quickly form dozens of tiny plants in this way. In our climate, where the trumpet and star gentians are comparatively easy to grow, much of the glamour is lost from the Himalayan gentians. Perhaps if they are grown longer in our climate they will adapt to less moist conditions. For the time being, this group is probably better grown only by the most enthusiastic gentian lovers.

The same should not be said of the Japanese gentian. There are few garden plants that could compare with this group for ease of culture, showy flowers or elegance of form. Although most forms of *Gentiana scabra* Bunge begin to bloom in September, October and November are the months in which it comes into its own, for when all the annuals are killed by the first frosts, and few perennials are in evidence, the Japanese gentian will be a mound of buds and startling flowers. The many forms of the Japanese gentian resemble the Caucasian gentians superficially: their stems are more wiry, the leaves a more powdery blue color, and the whole plant seems suffused with purple and grey tones that never are found in the glossy-green Caucasians. The flowers of Japanese gentians run the entire spectrum of blue, sometimes suffused with purple as well. These are among the easiest gentians to grow from seed, blooming the second year after sowing. The variation in size, color, and texture in this group is remarkable — all the forms are well worth searching out and growing. *Gentiana scabra* var. *buergeri* sub-var. *saxatilis* Honda is an easy alpine dwarf, rarely exceeding six inches in height or breadth, with paler flowers than the type. *G. scabra* var. *buergeri* Miq & Maxim is a much larger form with immense purple-blue flowers, which

splays out on the ground, sending out upright flower stalks from all the leaf-nodes on the upper part of the stem. Once established, the gentians in this group will tolerate drier conditions than any other members of the group. They enjoy a fuller exposure to the sun than other gentians as well. These are perfectly easy to grow under ordinary border conditions in Colorado.

Gentians hardly need to be banished to the mountains or allowed to languish on calendars. They are examples of one of the many groups of choice garden plants that will, in fact, grow better in our dry upland climate (given a little forethought and attention) than in the humid lowlands where they are more frequently grown. With the omnipresent blue of our Colorado skies, our mountain lakes, even our State Flower and State Flag, it is only proper that we introduce a little gentian blue to our gardens.

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Gentiana verna L.

Exotics of COLORADO

Convallaria majalis

Lily of the Valley

Helen Marsh Zeiner

Lily-of-the-valley, *Convallaria majalis* L., is a favorite old-fashioned garden flower for shady places. It has been cultivated in European gardens from very early times, and came to American gardens with early settlers from Europe. Lily-of-the-valley has been identified in the detailed garden scenes appearing in illuminated manuscripts of the Middle Ages. European garden forms of *Convallaria majalis* were developed from the wild plant found growing in moist, shaded sites in Europe and eastern Asia. *Convallaria majalis* is also endemic to the mountains of Virginia and South Carolina, where it is frequently found in moist mountain valleys. *Convallaria majalis* is regarded as a single wide-spread species.

The common names "lily-of-the-valley" and "valley lily" are reflections of its preferred natural habitat — moist valleys. "May lilies" is a common name related to time of blooming. "Our Lady's tears" is a fanciful common name. The botanical name also reflects habitat. The old name for *Convallaria majalis* was *Lilium convallium*. *Convall* is from the Latin and means "a valley". *Majalis* means "of May" or "of May-time." *Convallaria majalis* is a member

of the lily family, Liliaceae. Some botanists divide the lily family into several smaller families and occasionally *Convallaria majalis* is listed as belonging to the family Convallariaceae.

Convallaria majalis is often treated with bulbs, but it is not a bulbous plant. It has slender rhizomes from which the leaves arise. The erect parts are usually called pips. When the plant blooms, it sends up an angled scape bearing a one-sided raceme of sweet-scented, nodding, bell-shaped, waxy-white flowers with six recurved lobes. It is grown for these dainty, fragrant flowers which have also made lily-of-the-valley useful in wedding bouquets, nosegays, and garlands. The fruits are small, globular, few-seeded red berries.

Lily-of-the-valley is a perennial which spreads by means of its rhizomes. This makes it suitable for a ground cover in shady places, but it also makes it possible for it to become a pest because it spreads into beds and borders where it crowds other flowers. Old beds of lily-of-the-valley often become crowded and produce few blooms. To prevent this, plants in old beds should be separated in

the fall and the largest and best pips replanted. For best results with lily-of-the-valley, grow in shade or partial shade in soil enriched with plenty of humus, keep the soil moist and divide the plants frequently enough to prevent the beds from becoming crowded.

Lily-of-the-valley is now available in a pink-flowered form, *Convallaria majalis* 'Rosea,' and in a double form, *Convallaria majalis* 'Flore Plena.'

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Lily-of-the-Valley

Conservatory Ground Cover

Andrew Pierce

One wonders if three pairs of eyes are not required in the Conservatory — one for normal levels, a second up to the epiphytes, and last, though perhaps not least, down to the floor to view a minutely leaved or colored ground cover. Little children, who are often more interested in the turtles and fish, seem to notice ground covers more and ask the occasional questions as to their whys and wherefores. Some 10% of the plants in the Conservatory are grown on or very near ground level, but because of planting density numbers are unobtainable.

What is a Ground Cover?

Generally, a ground cover plant has to have the adaptability to spread and cover the ground and at the same time be attractive, has to require little maintenance, and be able to stand up to low light. Often they spread by adventitious shoots and runners or expanding like any other herbaceous plant. The largest problem that they have to contend with is low light, often the levels fall below 100 foot candles and you can notice how much better some areas are growing due to the introduction of gro-light tubes. Some plants such as the original ivy (*Hedera helix* Lowe Fl. Mader.) or wandering Jew (*Tradescantia*) are much more tolerant. Even though the latter loses much of its true color and appears green, it at least flourishes. Other plants

are not nearly as tolerant and their position has to be chosen so that they catch at least some of the filtered sunlight. An example in this area is *Plectranthus coleoides* Benth. cv. 'Marginatus' which, given the right light, stays reasonably dwarf and full of variegation but if planted where it is darker, grows leggy and turns almost dull green.

Species Introduced

Over the past year or so an effort has been made to introduce new species and varieties, and you will see more use of various peperomias and members of the prayer plant family, Marantaceae, which includes not only *Maranta* but the colorful *Calatheas* and *Ctenanthe*. The plants have quite insignificant flowers but the beauty of their multicolored foliage is well worth looking out for. *Calathea zebrina* Lindl. cv. 'Humilor' has caught the public's eye more than any other member of this group; it is fast growing, and seems more tolerant to shade than some.

Another plant that is proving popular is a member of the *Tradescantia* group called *Tripogondra multiflora* Sw. This plant has very small, dark green leaves with myriads of tiny, three-petaled white flowers. Many of this family, Commelinaceae, are not noted for their flowers but this is an exception. Not far

away in growth habit, but of course a long way in relationship, is the variegated St. Augustine grass, *Stenotaphrum secundatum* Walt. var. *variegatum*. This low-matting ground cover is another popular one with visitors.

One that has been in the Conservatory for a considerable time is baby tears or *Helxine soleirolii* Gaud.-Beaup. This plant has the smallest of leaves but unfortunately is easily damaged by avid photographers and others who find the paths insufficient in size.

Maintenance and Propagation

Due to the traffic problem and regular work required to maintain and prune the other plants, some ground covers suffer rather badly, and consequently, have to be replaced more frequently than might be desired. Two that have this problem are the variegated form of *Senecio macroglossus* D.C. and *Iresine herbstii* Hook. Both are easily reproduced by cuttings as are the majority of the ground covers, and this enables the staff to replant an area quite thickly with an adequate number of plants for a quick cover. Many of the plants have to be pinched back so that they spread successfully. *Pilea* and *Plectranthus* are in this group, and at the same time others that are evasive have to be pruned back or weeded out. Prime culprits here are of course the very rampant ivy and *Tradescantia*.

As we have already stated, an ideal ground cover is "attractive, fast growing, relatively insect free, traffic tolerant, and of low maintenance." I don't think the time can be visualized when we can do away with *Hedera*, *Glecoma*, or *Tradescantia*, the great low light trio, or for that matter do we need to, but there will be other introductions made, especially in such genera as *Peperomia*, *Maranta*, *Begonia*, and possibly members of Gesneriaceae, the African violet family. The limited space of the Conservatory can be better utilized even to the extent of growing a three-inch high bamboo. More accent can be made not only with color of leaves but with their shape and texture as well.

Another area of limited development can be made in the use of larger plants as ground covers. Some examples are *Spathiphyllum*, *Gerbera*, *Eucharis*, *Impatiens*, and *Clivia*. While not perhaps strictly ground covers, they do often serve the same purpose on a larger scale with the added asset of periodic flowering.

It would be marvelous to have the ultimate of a low-growing, colorful, maintenance-free, low-light-loving plant, but at present it appears as if nature hasn't come up with the right combination.

Many of the ground covers in the Conservatory are unfortunately omitted from such a short article as this, but a visit could well repay one's curiosity.



Looking Up in Conservatory

Birch and Maple in Colorado

Larry Watson

Rocky Mountain birch and Rocky Mountain maple, both native to Colorado, offer welcome additions to our landscapes either as large shrubs or small trees.

Betula fontinalis Sarg., Rocky Mountain birch, is found along the banks of many streams in Colorado at altitudes from 5,000 to 9,000 feet. Normally a multi-stemmed plant it can be pruned into a single trunk tree and will reach 30 to 40 feet at maturity.

As opposed to the characteristically white-barked birches of other areas, our native birch has a cherry-like bark with prominent white lenticels. The resinous appearance on the small twigs looks almost "sugar-coated." While effective as a screening shrub it is even more striking when used as a clump specimen tree to expose the beauty of its red bark dotted with the white lenticels. This technique truly enhances a winter landscape.

Rocky Mountain birch requires no particular soil type but as its other common name, water birch, implies, it needs adequate moisture and is not a native suited for dry land conditions. Home gardeners and landscape planners have found it difficult to transplant in typical bare-root fashion. Nurseries have solved this problem by offering container-grown plants.

Acer glabrum Torr., Rocky Mountain maple, is more particular about soil preference and is much happier in well-drained or loose, gritty soil. In heavy wet clay it often becomes stunted as well as chlorotic. An extremely hardy plant, it adapts readily to mountain

living or plains living and affords contrast among evergreen plantings. It, too, can be grown as a large shrub or small tree depending on the grower's wishes and willingness to prune. The plant grows from 6 to 20 feet tall and is basically round in shape. It is common in canyons and on hillsides from 5,000 to 10,500 foot elevations in Colorado.

Identifiable characteristics include three-lobed leaves, grey bark, and yellow fall color. Young twigs are dark red and winter buds bright red. Another native maple, *Acer negundo* L., has compound leaves with greenish or purplish twigs. *A. glabrum* can be confused with two imports, *A. tataricum* L., and *A. ginnala* Maxim.; tatarian maple leaves are not lobed but ginnala maple leaves are lobed and fall color is red.

Rocky Mountain maple is available in nurseries primarily as a shrub, usually as 2 or 3 foot plants.



Betula fontinalis Sarg.

Rare Rhododendron

Andrew Pierce

During October 1977 a rare and enormous rhododendron bloomed in the Denver Botanic Gardens greenhouse, *Rhododendron leucogigas* Sleumer. This Malesian rhododendron from the Cycloop Mountains in northern New Guinea was discovered as recently as 1961 by H. Sleumer of the Rijks-herbarium, Leyden, Holland. Details of it along with descriptions of other new species of the area were published in 1966.

The plant has perhaps the largest leaves, as much as 36 cm in length, and flowers, sometimes 14 cm across, of any of the Malesian species and grows on tree trunks in the riverine forest or in sub-mossy Nothofagus (southern beech) forests at an elevation of 1200 - 1350 m. It cannot of course be considered hardy in our area but is succeeding, with some winter protection, at Strybing Arboretum in California where it was sent in 1963 from Holland.

Our plant was received as a young potted cutting from Longwood Gardens in April 1970 and it has taken until now to flower in the greenhouses. The first flowers in cultivation were seen at Boskoop, Holland in 1964. The overall height of our plant is only 0.5 m but in the wild it reaches 3 m. The flowers are creamy white with carmine, mainly on the veins and at the top of the corolla tube by the petal bases. They are borne in whorls of nine and are very large for a rhododendron. Their scent which is somewhat like that of a carnation is a real delight. The period of blooming is

approximately two weeks but with two stems flowering, our display lasted most of October.

With such a distinctive flower and scent it is obvious that this plant will be used for hybridising in the future. Given a stronger color it has great potential.

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Sleumer, H., 1966. *An Account of Rhododendrons in Malesia*. Groningen, The Netherlands: P. Noordhoff Ltd.



Rhododendron scabridibracteum Sleum. (This *Rhododendron* is in the same series as *R. leucogigas* Sleum.)

Patio Totems

Larry Latta

When space is at a premium, plant totems can be used to add a bit of color and greenery to a patio or balcony. They are simple to make.

From a 3 foot wide roll of 1/2 inch mesh hardware cloth, cut off the length required to roll a cylinder of sufficient diameter to fit snugly into an azalea (wide-bottomed) pot of whatever size you wish. For stability, the minimum pot size recommended is 8 inches; 10 inches is better. When cutting the length of hardware cloth, add 2 squares to your measurement so that when rolled up, the ends will overlap. Wire the cylinder closed at each end and at 8 - 9 inch intervals along the overlap.

Line this cylinder with heavy black plastic cut the same size. For stability, place a layer of stones or gravel in the bottom of the pot. Then fit one end of the lined cylinder vertically into the pot and holding the plastic lining secure, fill it and the pot with soil. I recommend using one of the packaged "dirt-less" soils based on peat, woodchips, etc., with a slow-release fertilizer added.

To plant, snip out squares of wire at 8 to 10 square intervals horizontally and vertically, spacing each horizontal row of holes half-way off center from the row above. Therefore, vertically, the holes are staggered for more uniform coverage. The holes should be not quite large enough to accommodate the root balls of the plant: 2" across, maximum. Now, in each square hole, slit the plastic with an X from corner to corner, exposing the soil inside. Slightly hollow a space for the plant roots. Holding the plant by its stem, gently loosen the soil

around its roots and compress the root ball enough to stuff through the square snipped in the wire and the X slit in the plastic. With the roots inserted into the cylinder, un-tuck the flaps of the X and add soil if necessary to secure the plant.

When all the plants are in place, water thoroughly.

Some amenable annuals for patio totems are: petunias, *Catharanthus roseus* (L) G. Don (*Vinca rosea* L.),

Immature seedlings or rooted cuttings are more satisfactory than older plants grown to large size.



Timberline Giant

FUND CAMPAIGN

After several years of serious consideration the Board of Trustees of the Denver Botanic Gardens authorized, early in 1977, a public subscription fund-raising campaign to help meet the current and foreseeable needs for expansion and improvement of the gardens. The campaign is entitled "To Fulfill a Promise" and its purpose is threefold: completion of the York Street Gardens Complex, long range development of Chatfield Arboretum and expansion of the Endowment Fund.

The goal of the drive is substantial — \$1,500,000 in tax-deductible contributions solicited from interested citizens, corporations and foundations. These funds will be used for the following purposes:

\$250,000 for the expansion of the participatory Gardens for the handicapped, senior citizens, children and families.

\$200,000 for a master plan, design, water development and initial plantings of an arboretum at the Chatfield Recreation Complex.

\$500,000 for an endowment fund to ensure the margin of excellence for the Gardens in the years ahead.

\$110,000 for the completion of a Rock Alpine Garden.

\$250,000 for the completion of the Japanese Garden.

\$150,000 toward the Orchid and Bromeliad Display Greenhouse.

\$ 40,000 to drill a deep water well for a continuous supply of untreated water.

The support for this program has been impressive. Mr. J. F. Baxter, Chairman of the Board & President of Western Federal Savings & Loan, volunteered to serve as Chairman of the drive, with Richard Kirk, President, United Bank of Denver and John C. Mitchell, Vice President, Boettcher Foundation, serving as his co-chairmen. Other prominent citizens and volunteers have gathered behind their leadership.

With the cooperation of many interested friends and members, the Board of Trustees reports a most gratifying response to this drive. Nearly \$1,400,000 of the \$1,500,000 has been raised, but we must raise more than \$1,500,000 to meet our goal.

All of the gifts received, small and large, have been thoughtfully given. The joy and rewards of a capital fund-raising drive far outweigh the frustrations and disappointments.

The sense of satisfaction, the camaraderie of enthusiastic workers and the shared excitement and success of a job well done for a one-time effort to a common goal will enable the Denver Botanic Gardens "To Fulfill a Promise".

To those who have given — Thank You. To those considering a gift, your gift *can* make the difference.

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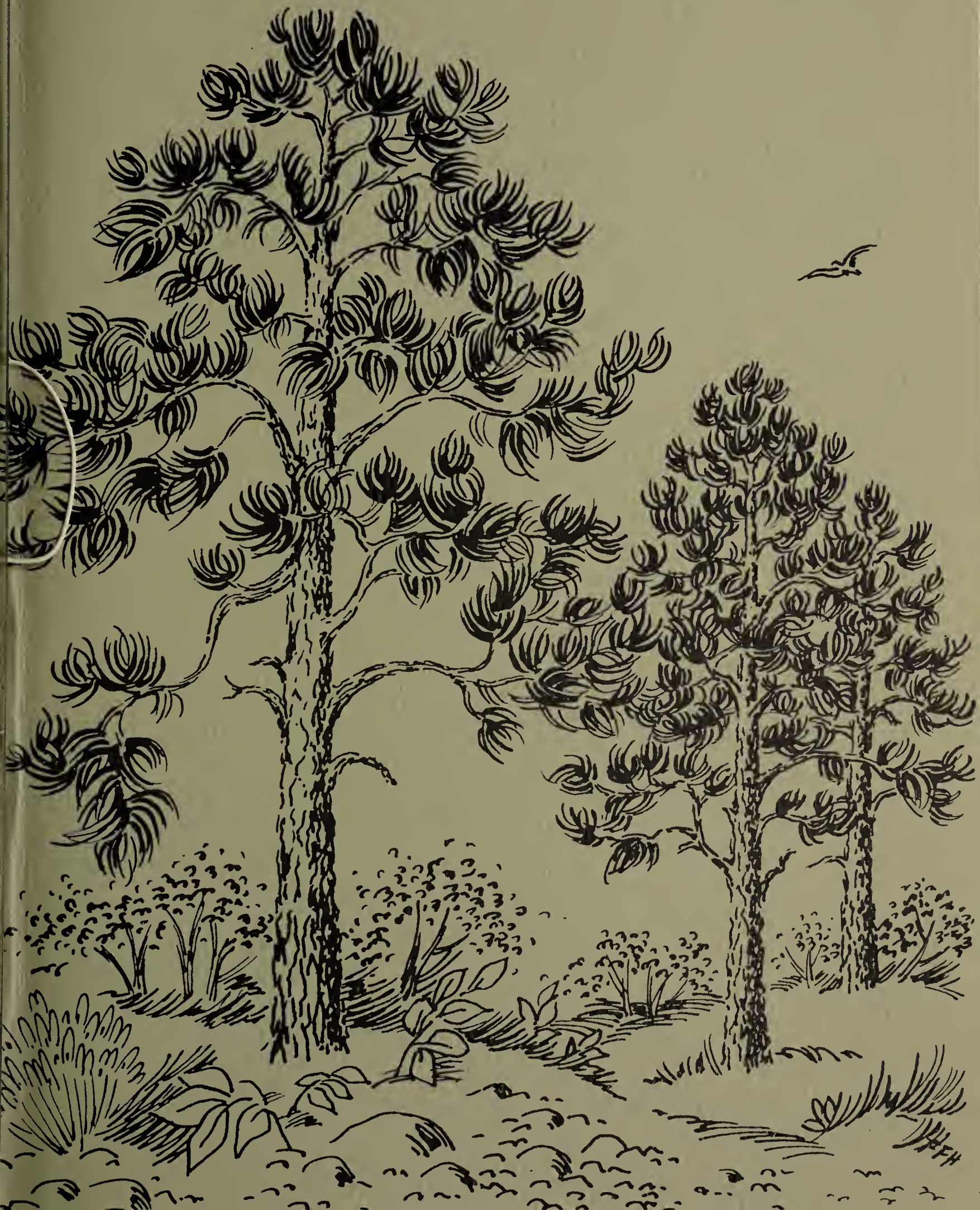
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The Green Thumb

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SUMMER 1978



THE COVER

Pinus ponderosa Laws
var. *scopulorum* Engelm.

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SUMMER 1978

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Pine Beetle — Friend or Foe?

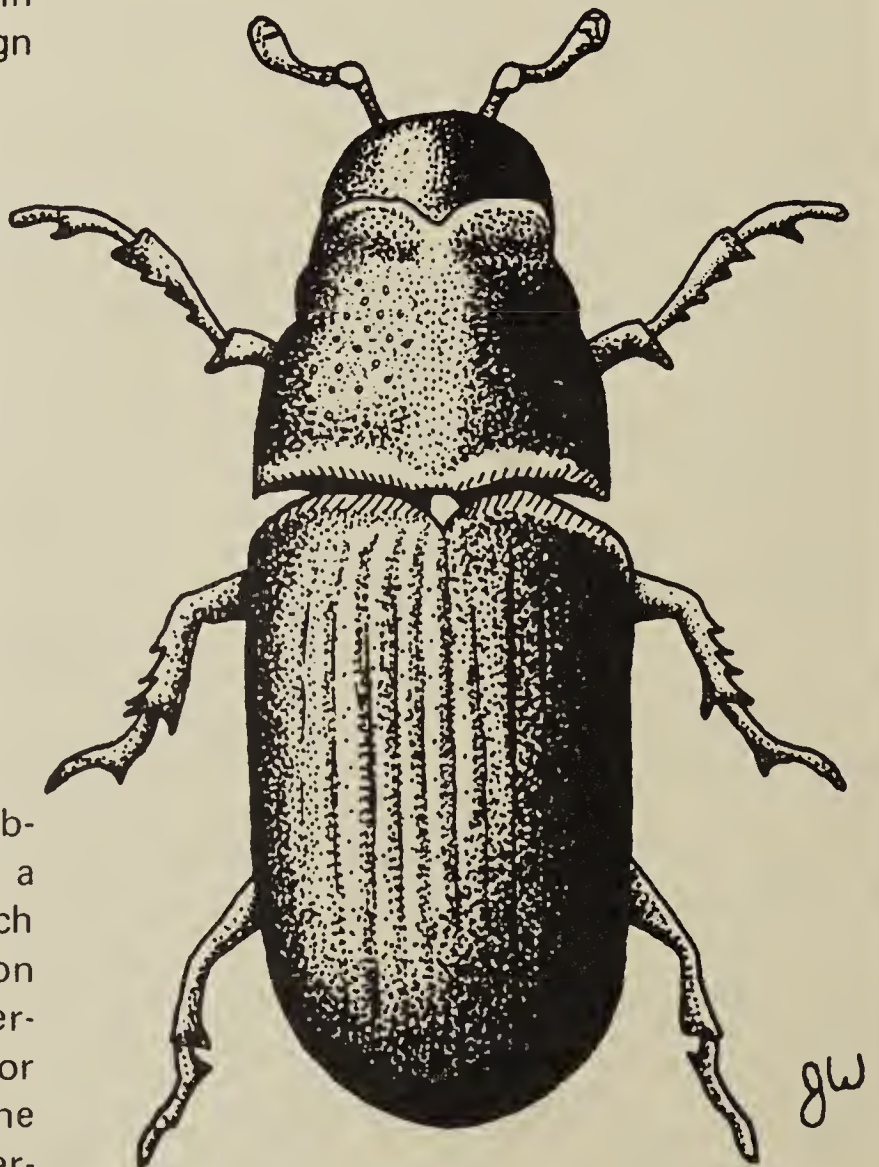
Much public interest has been expressed in the last few years in the infestation of the mountain pine beetle and the consequent death of many ponderosa pines. Several public agencies have been attacking the problem along the front range of the Rockies. Procedures followed and philosophies expressed are somewhat different. The four following articles give a good explanation of what has been done and what will be done locally.

Ed Menning

Below one of the viewpoints within Rocky Mountain National Park is a sign stating:

"The Mountain Pine Beetle — Friend or Foe. This small insect, like natural fire, plays an important role in the perpetuation of the montane forest ecosystem. It removes overmature trees and thins dense stands. In the Park, such attacks are allowed to run their course. Control measures are taken, however, when the outbreaks threaten areas outside the Park or developed areas within the Park."

Why has such a policy been established? One must understand what a National Park is to understand how such a policy came into effect. One mission of the National Park Service is to perpetuate those inherent qualities for which a park was established. The concept is to perpetuate the full diversity of a natural environment or ecosystem, as compared to the protection



Dendroctonus ponderosae Hopkins

x15

Mr. Menning holds the position of Resource Management Specialist for Rocky Mountain National Park.

of individual features or species. Policy and management emphasis is toward perpetuation of those natural processes, assuring that impacts are not irreparable.

In a Technical USDA Report, "Mountain Pine Beetle in Front Range Ponderosa Pine, 1975," the following statement is made:

"Both trees and beetles have persisted for thousands of years, and there is no reason to expect total devastation of the ponderosa pine forests. Locally, however, tree killing has been and will continue to be, severe in overstocked and marginal stands."

Nature's Course

The resource management objectives of the National Park Service include insect and disease control:

"Native insects and diseases existing under natural conditions are natural elements of the ecosystem. Accordingly, populations of native insects and the incidence of native diseases will be allowed to function unimpeded except where control is required: (1) to prevent the loss of host or host-dependent species; (2) to prevent outbreaks of the insect or disease from spreading to forests, trees, other vegetative communities or animal populations outside of the area; (3) to conserve rare, threatened, endangered, or scientifically valuable specimen plants or unique plant communities; or (4) for reasons of public health and safety."

The Park's control program is based upon items (2) and (4); there is no threat of host loss or involvement with rare, threatened, endangered, or scientifically valuable specimen plants or unique communities.

A total of 20,000 acres of the montane ecosystem which includes the ponderosa pine is located within Rocky Mountain National Park from an elevation of 7,800 to 9,000 feet. Most of the ecosystem (19,300 acres) is adjacent to Estes Park, while about 700 acres are scattered in four clusters near Camp St. Malo, Meeker Park, and Wild Basin. In an effort to work with the adjacent Estes Park and Allenspark communities, the Park included 2,000 acres of the ponderosa pine ecosystem within their Designated Control Areas (DCA). About 1,350 acres are within the Estes Park DCA and 650 acres within the Allenspark DCA. The original control zone included only a 1/8-mile buffer zone along the east boundary of the Park. Most of the Park's area within the DCAs is along the boundaries or includes campgrounds, picnic areas, maintenance areas, and similar developments. Control of trees along the boundary is a management program to prevent the mountain pine beetle from spreading to areas outside of the Park; control of the beetles within developed areas is designed to remove hazardous trees and to preserve landscape values.

Control efforts within the Park have been similar to other areas within the state — direct control. This method involves felling the tree and spraying it with ethylene dibromide (EDB). Lindane, a chlorinated hydrocarbon, is used by some communities for treatment, but it is banned by the Department of the Interior for use on public lands due to its persistency in the environment. Tree removal during the past five years has been as follows: 1973, 329 trees; 1974, 180 trees; 1975, 540 trees; 1976, 430 trees; 1977, 375 trees. Except in some areas, all of the infested trees, including slash, are removed from the treatment site.



Cut Logs Ready for Treatment

One control method recommended by the National Forest Service, but not applicable within Rocky Mountain National Park, is silvicultural control. In practice, this means thinning dense stands of trees of sufficient size to support an infestation. Outbreaks usually develop in those portions of stands with basal areas over 150 square feet per acre and with most trees over 8 inches. Thinning reduces competition, increases tree vigor, and reduces susceptibility to insect attack. Some researchers believe that forest fires historically have thinned forest stands to minimize infestations such as dwarf mistletoe, forest insects infestations, and forest diseases. In Rocky Mountain National Park, a natural fire management plan has been implemented to allow natural fires (lightning strikes) to burn in certain areas under certain conditions. Supplementing this program is a prescribed fire management program in areas where natural fires are not allowed. One effect of the programs will be to thin dense stands susceptible to insect epidemics.

In 1977, the Park decided to experiment with a new treatment technique — cacodylic acid (Silvisar 510). The chemical is injected into a tree with a hypohatchet, which injects 1 ml. of chemical for each stroke. For trees below 8 inches in diameter, one cut per 2 inches is applied; for trees above 8 inches in diameter, one cut per 1 inch is applied. Timing is critical, since this chemical needs to be injected within a newly infested tree before any larval galleries exceed a half-inch in length. If treatment is after the critical time, then the blue stain fungi carried by the beetles will clog the tree's transportation system, and the chemical will not be translocated within the tree. Treatment kills both the tree and the beetle larvae, but the beetles would normally kill the tree once it is attacked. Benefits include (1) survey and treatment are accomplished during the same period (August-September 15) and (2) the need to remove the trees is eliminated. The primary benefit of the program is reduced ecological damage. The appearance of stumps is not natural to the Park environment. Standing dead trees are natural to the environment and provide homes for tree-nesting birds. The chemical does not have any secondary effects on non-target insect species nor wildlife. In 1977, 635 infested trees were treated with cacodylic acid; preliminary monitoring during the fall of 1977 indicates a 90% success rate; additional monitoring, however, during the spring of 1978 will reveal more accurately the success of the program.

The mountain pine beetle control program has been assisted by the Youth Conservation Corps (YCC), youths ages 15 through 18, who have removed the trees and slash from the treatment site. In 1978, the survey-treatment program will receive assistance from the Young Adult Conservation Corps (YACC), which employs youths ages 16 through 23 on a 12-month basis.

Public comment on the mountain pine beetle interpretive sign has been supportive. The American people acknowledge that the objectives of national parks differ from other land management agencies. Management of Park lands is concerned with ecological processes and the impact of people upon those processes and resources. Basically, the philosophy of Rocky Mountain National Park is that the landscape is like an outdoor museum where the processes that shaped the mountains and developed the ecosystems as they are today should continue.

Freeman Tilden best captures the essence of a National Park:

"So we see that national parks are really national museums. Their purpose is to *preserve* in a condition as unaltered as possible the wilderness that greeted the eyes of the first white man who challenged and conquered it. It is to ensure that the processes of nature can work without artifice upon all the living things, as well as the earth forms, within their boundaries. It is to keep intact in the wilderness areas all the historic and prehistoric evidences of occupation by our predecessors and, in doing these things, the extra reward of recreation value emerges."

Management Must Look To Future

Pamela Patrick

When the first pioneer set foot on what was to become Colorado soil, he looked to the trees of the mountain forests for his shelter and sometimes for his living.

In the 1860s, when gold and silver were bringing hundreds of settlers to this area, there was so much timber here for the cutting that just about everyone took the best wood for his home and for shoring up the thousands of mines that were being dug — and left the weakest to propagate.

Old photographs show that as a result of the heavy logging by the turn of the century many mountainsides along the Front Range were practically denuded. Of course trees grow back, but since the early settlers, miners, and loggers high-graded the forest — took only the best wood — they left a small, weak forest to propagate itself.

If high-grading weren't enough to get the remaining forest off to a bad start, people living in or near the forest compounded the problems by interrupting natural selection when they put out forest fires. And on top of that, the strong public feeling in favor of preservation and conservation has, since early in this century, prevented almost anyone from cutting trees in any significant number along the Front Range.

So for years we've "managed" forests enough to stop wildfire, but we haven't managed them enough to replace the natural cycles through which weak and old trees are weeded out.

The result is the weak, diseased, and even dying forest that now stands along the Front Range. It is primarily an even-aged forest, comprised mostly of ponderosa pine, and it is overstocked. So weak trees grow weaker and more susceptible to disease in stands where they compete for scarce soil nutrients and even scarcer water.

This forest is an ideal feeding ground for the mountain pine beetle and many other pests. The two most predominant besides the mountain pine beetle are the western

Pamela Patrick is the Public Information Officer of the Front Range Vegetative Management Pilot Project.

spruce budworm and dwarf mistletoe.

Mountain pine beetle is the most obvious pest. It isn't new to this region, but because forests have not been effectively managed since humans became permanent residents, the beetle infestation has become epidemic. The tiny mountain pine beetle is only about the size of a match head, but by 1975 it was responsible for killing about two million trees annually along the Front Range, according to Colorado State Forest Service figures.

Mountain pine beetle usually attacks ponderosa pine in this area, but in other parts of the West many different kinds of pine serve as hosts. In Colorado, the beetle has a one-year life cycle, usually beginning between July 15 and September 15 when adult beetles fly from the tree in which they were hatched to attack a new tree.

In the new tree, the beetle drills through the bark and lays its eggs between the bark and the wood. A healthy tree often produces enough sap to keep the beetle from



Limbing a Felled Tree

getting to the wood, and unsuccessful beetle attacks are marked by "pitch-outs" — globs of sap on the outside of the tree where the beetle tried and failed to get through. Once the eggs become larvae, sometime during the winter, they feed on the tree, burrowing at right angles to the vertical line along which they were laid. When they are mature, they simply drill an exit hole and fly to the next tree.

Although the beetle hampers the operation of the tree by feeding on the cambium, the living part of the tree, it is a blue fungus that the beetle carries with it that actually kills the tree. The fungus penetrates throughout the wood, staining it a light blue or gray color and choking off the flow of water and nutrients, killing the tree. Successfully attacked trees die almost immediately, although they may not begin to fade from green to brown for as much as a year.

Western spruce budworm also infests many Front Range forests, concentrating on Douglas-fir. The budworm is actually a moth in its adult stage, and it feeds on the needles of the fir, occasionally eating spruce and various pines too.

Brown or gray moths with a wing span of about one inch appear in July or August. One female moth can lay up to 100 eggs on the underside of needles; the eggs will hatch in about 10 days, when the larvae spin silken hibernation shelters under bud or bark scales or in bark crevices. The following spring, usually in May, they emerge, and mine into old needles or unopened buds, moving on to expanding buds and then new foliage. Although a prolonged attack can destroy a tree, the budworm usually only weakens it and sets the stage for other insects.

Dwarf mistletoe is related to the Christmas variety but it is smaller, leafless, and grows on branches and trunks of cone-bearing trees, usually on ponderosa and lodgepole pine in the central Rockies. Although both male and female plants damage the tree, only female plants produce seeds to spread the disease. In August or September, pressure builds up in mistletoe berries on female plants, eventually breaking the berries away from the stems, and shooting the seeds off at 60 mph, traveling for up to 20 or 30 feet. A gluey coating on the seed helps it stick wherever it lands.

Rains wash the seeds from the needles of a tree to the twig where they germinate and infect the twig. In about two years, a swelling appears and in another two years, small shoots emerge at the site of the swelling. It takes two more years before the berries on the plant become mature, and shoot off to infect another tree.

Mistletoe slowly weakens a tree by robbing it of food and water. Eventually, the tree will die, but more often, the weakened tree will be attacked by mountain pine beetle or other insects.

In the past, much forestry activity along the Front Range has centered on controlling the mountain pine beetle by cutting and treating infested trees.

Although this kind of short-term, direct control can lower the mountain pine beetle population in a particular area, unless the condition of the forest that supports a pine beetle epidemic is changed, the beetles and other insects and parasites will continue to flourish.

According to the best available research from the Colorado State Research and Experiment Station, long-term, forest-wide management can help to establish healthy, vigorous forests that can, through natural defense mechanisms, keep insect populations under control.

That kind of management is the aim of the Front Range Vegetative Management Pilot Project. For the first time, five government agencies: U.S. Forest Service, Colorado State Forest Service, Bureau of Land Management, Boulder County Parks and Open Space, and the City of Boulder have pledged to work together on a total forest management program.

Perhaps the most important participants are the landowners who control about 20,000 acres of forested land within the 34,000 acre pilot project area. The five agencies are working with the landowners in managing forests on the private land.

It was also the landowners in this area who were instrumental in getting the project funded for Boulder County. Their enthusiastic work in fighting the pine beetle convinced those in Washington, D.C. that there was enough public support to warrant this project being placed in Boulder County.

The project has \$3.5 million in federal, state and local matching funds to prove its point: that forest management can make a difference in the pine beetle epidemic and in the condition of the forest. In addition, there is a one-year deadline. Project funds are good until Oct. 1, 1978. There will be hearings before that date in Washington to determine if the project has paid off, and if it will be expanded to include the whole Front Range.

It is important to recognize the scope of the Front Range Project as not just a beetle program. According to Project Coordinator Ron Gosnell of the State Forest Service, "The beetle epidemic is only a symptom of the condition of the forest. Cutting only beetle infested trees is useless unless you also change the condition of the forest."

Foresters and about 200 crewmembers are cutting not only infested trees but are thinning healthy trees to improve the forest. By decreasing the density of the stands, foresters hope to encourage faster growth and greater health in the remaining trees, at the same time improving wildlife habitat and reducing fire hazard. Thinning in a forest works much the same way it does in a vegetable garden. Every home gardener knows that some perfectly healthy carrots must be pulled in order to make room for others to grow strong and healthy.

"We're trying to mock natural selection," Gosnell said. "We have the choice of thinning the forest ourselves or waiting for the beetle to do it for us and then live with an enormous fire hazard. I'd rather see man replace the natural selection we've taken away and help create a safe, enjoyable forest along the Front Range."

Constant Effort Needed

Stanton G. La Breche
Frank Kunze

Jefferson County Open Space manages 9,000 acres of mountain land in the Montane Zone of Jefferson County, Colorado. This acreage is contained on eight parks that range from the north end to the south end of the county.

It is the goal of Jefferson County Open Space to promote the health and vigor of the parks' forests through proper forest management practices. These management practices include insect and disease control, with the biggest problem being mountain pine beetle (*Dendroctonus ponderosae* Hopkins) on the ponderosa pine. Other insect and disease problems that we deal with are IPS beetles (bark beetles), (*Ips pini* Say), spruce budworm (*Choristoneura fumiferana* Clemens) on Douglas-fir, and dwarf mistletoe (*Arceuthobium vaginatum* (Willd.) Presl.) on ponderosa pine. Management practices also include forest fire protection and the reduction of fire hazards possibly to prevent devastating fires. Prescribed thinnings are used to achieve proper spacing for optimum tree growth. We are trying to accomplish these forest management practices while keeping in mind that the ultimate use will be recreational.

Since the start of our mountain pine beetle (MPB) program in 1975, we have treated 13,300 trees. Our treatment program consists of marking infested trees as soon as the flight of beetles is over, around the first of October. Then we fell, limb, and buck the main stem into 4 foot lengths and stack them in piles. At this point we coordinate with the state forest service for chemical treatment. This consists of trenching around the piles, treating the piles with ethylene dibromide (which is a fumigant that is biodegradable in 72 hours), and cover with 6 mil. clear plastic.

Mr. La Breche is the Jefferson County Open Space Maintenance Supervisor, and Mr. Kunze is the Open Space Forester. Jefferson County, Colorado has quite an ambitious program of providing open space in the foothills.

This past year we had a couple of outbreaks of IPS beetle killing large pockets of trees. Ordinarily these pests feed on dead wood but they carry the same blue stain as the MPB and occasionally attack live trees. The treatment for this beetle is the same as for MPB. A good example of how our MPB program works can be found on Mt. Falcon Park. The first year we treated MPB we thinned out 1,700 trees. The second year we cut 1,000, then 500 trees, and finally we cut 300 trees this year.

Dwarf mistletoe is another problem that we have. Although mistletoe does not kill a tree as fast as MPB, it will deform and prevent natural regeneration of the stand and eventually the tree will die. Control starts with identifying the boundary of the infected group of trees. Then we use Frank Hawksworth's Mistletoe Rating System (1961) to determine if the tree can be pruned or has to be cut. Small pockets of mistletoe can be controlled in one year, but larger pockets will first have to be contained. Control of these larger pockets will take a few years.

We feel that proper forest management is the key to a successful MPB program. Forest management practices will increase the health and vigor of the remaining trees to a point where they have a better chance to resist beetle attack naturally.



Pointing Out Beetle Damage

A Day in the Field

Trish Lewis

Cutting crew #2 arrived at Ken Custer Ranch on Lookout Mountain by Genesee Park. Chaps and hatchets strapped on, chainsaws, sharpened, gas cans filled, and the eight man — two woman crew was ready.

They split into three groups of two and three, each group with a chainsaw, and continued cutting areas they began the day before.

Crewmember Priscilla Burgard felled the first tree, limbed and cut it into four foot sections. Her partner, Tony Wilarski, stacked the logs four feet high and scattered slash (branches) not more than 18 inches high.

Crew #2, Lee Overcamp, supervisor, is one of ten crews working on the Mountain Pine Beetle—Comprehensive Education and Training Act (CETA) Project, cutting Mountain Pine Beetle infested trees, the second phase of a three phase program.

Signs of attack are cream or red colored pitch-tubes on the tree trunk, marking beetle entry. Boring dust "frass" is found in bark crevices and around the tree's base. The definite sign of beetle attack is the blue-stain found under the bark a few months after attack. Successfully attacked trees die immediately and start fading six months to a year after the attack. The needles change from green to rusty brown before falling off.

CETA crews have located and marked 82,514 infested trees so far in DCAs including: Blue Mountain, Evergreen, Coal Creek Canyon, Conifer Meadows, Indian Hills, Double-Header/Aspen, Mt. Vernon Canyon, Phillipsburg, and South Turkey Creek. Trees were marked by tying marking tape around the trunk or spraying orange paint about four feet from the tree's base.

Overcamp's crew is in the second phase of direct control, cutting beetle infested trees. Infested trees are felled, branches trimmed off, and the trunks cut into four foot lengths. The logs are then stacked four feet high.

Crews will cut a minimum of 30% of the diseased trees in the various DCAs. Landowners are expected to do their part, cutting 70% of the trees in their areas. The crew's goal is to cut 60,000 beetle hit trees by June 30, 1978.

Additional crews will be hired in May to spray the cut logs with fumigant, ethylene dibromide. Heavy gauge plastic supplied by the landowner, is used to cover the logs. This seals in the fumigant and kills the beetle.

The insect isn't confined to Colorado and ponderosa pines, but is found over a wide area, from the Pacific Coast east, through the Black Hills of South Dakota, and from Northern British Columbia and Western Alberta, south to Northwestern Mexico. Infestations can occur in western white, sugar, whitebark, limber, bristlecone, pinyon, and foxtail pines.

In Colorado the insect mainly attacks ponderosa and sometimes lodgepole pines. Susceptible trees are overmature and at least six inches at breast height.

It began to rain. Crew #2 continued to work (about an hour) before packing their gear and driving the 3/4 ton crew truck safely from the mountain road.

Thirty-one beetle infested trees were cut before the downpour, making 431 trees cut out of the approximately 450 infested trees on Custer's 100 acre ranch.

Trish Lewis is in charge of public relations on the Mountain Pine Beetle Project for the Colorado State Forest Service.

From Cemetery To Conservatory

Part VI: Water on Top of the Hill

Louisa Ward Arps

[Note. This is the sixth of a series of articles published in *The Green Thumb* telling the history of the land around the Denver Botanic Gardens. The next, and last, article will deal with the Fire and Police Department buildings, the Old City Nursery and Victory Gardens, and present Congress Park.]

As long as little Denver contented itself with living on the flats on the banks of Cherry Creek and the South Platte River, its inhabitants, both man and beast, drank water from the streams, or from shallow wells dug behind their cabins. Soon the more fastidious bought spring water (or artesian water after 1883 when artesian wells were discovered) which was delivered in horse-drawn tanks at 5¢ a bucket, 10¢ if the water boy had to climb steps to the second floor.

The town had no trees (except cottonwoods along the river) and no gardens. It was a dry and dusty place until after 1867 when John W. Smith built the City Ditch which ran by gravity from the South Platte River to Brown's Bluff (present Capitol Hill). Water in small lateral ditches gurgled down the bluff to the flat town where the elegant brick homes on 14th Street boasted trees and gardens. The town hired 30 policemen to patrol the ditches, to remove wallowing pigs and to try to keep people from drinking the water.

In about five years, indoor plumbing arrived in Denver. An affable Irishman named Colonel James Archer formed a water company, along with Walter Cheesman and David Moffat. The company dug a sump 13 feet deep, 16 by 17 feet on the surface, into the sands of lower Cherry Creek, and lined it with peeled poles. From the pump house at 15th and Basset Streets four miles of pipe led to Denver houses and five fire hydrants. On a momentous day in January 1872, Colonel Archer turned on a fire hydrant at 15th and Larimer and water roared 100 feet into the air.

Almost immediately the system proved too small for the growing town, so the company moved upstream on the Platte, sank sumps into the sand, then made Lake Archer. In 1880 they built a sturdy stone building, another in 1882, another in 1905 at 12th Avenue and Shoshone, which are still in use.¹

Mrs. Louisa Ward Arps is a well known authority on Colorado history, with a number of books and many articles to her credit. She is a former librarian with the Denver Public Schools, the Western History Department of the Denver Public Library, and the State Historical Society. She is a frequent contributor to *The Green Thumb*.

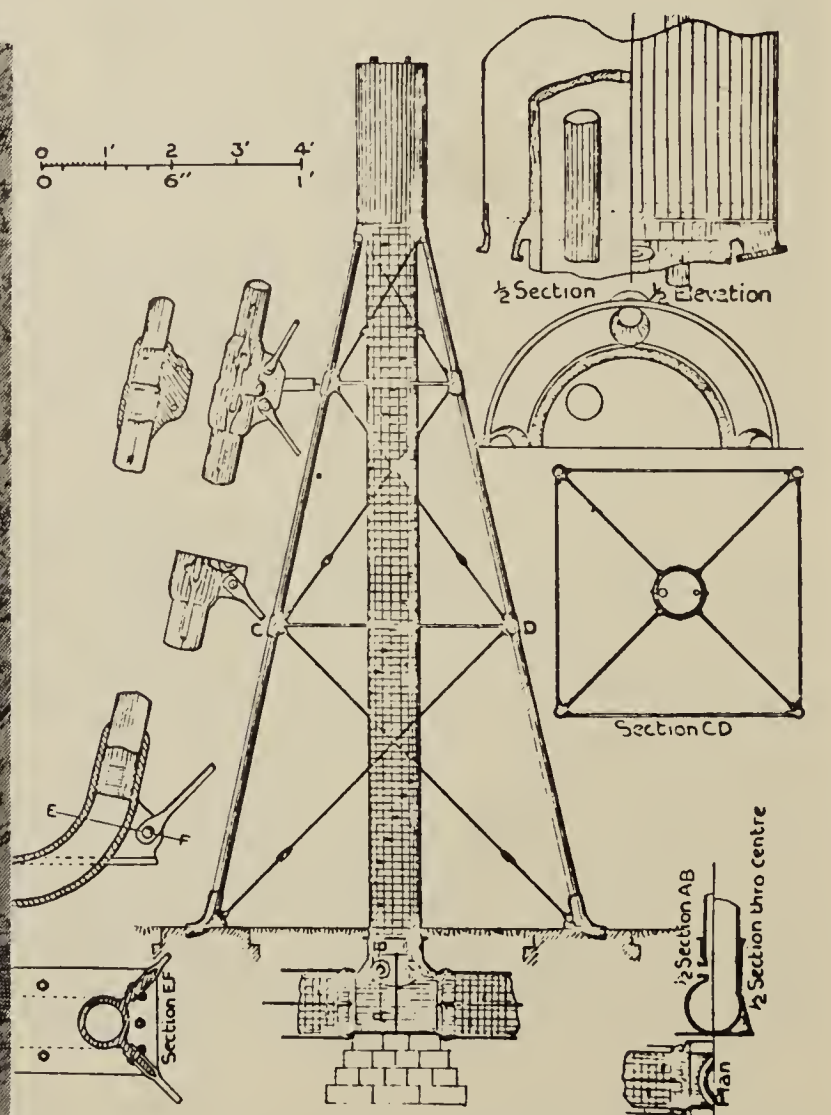
Reservoir on Cemetery Hill (Basin #1) 1888

By the early 1880s, Denver had climbed Brown's Bluff and headed east. Canny real estate men plowed out street outlines on the prairie and sold home sites west and north of Cemetery Hill with vague promises of water to come. If only a reservoir could be built on top of the hill, gravity would carry water into the homes.

The idea of this efficient system dates back to 1882.² Nothing came of it until February 25, 1887, on which date the Board of Aldermen of the city of Denver leased to a Denver water company 10 acres of land east of the Jewish Cemetery.³ The annual rent was \$500.⁴ The company planned to build a reservoir, but where to get the water to fill it?

Its engineers rode nine meandering miles up Cherry Creek until they were 14 feet higher than the top of Cemetery Hill. Gravity makes water seek its own level. Here the company sank three wells from 20 to 35 feet deep, into which they lowered large wooden barrels, and called the project the Cherry Creek Galleries.

To carry the water from the wells to Cemetery Hill, the company laid 5.76 miles of wooden pipes. Think of the man-hours of carpenter work required to make almost 6 miles of wooden pipes! The pipes measured 30 inches in diameter inside the curved staves, which were 2 or 3 inches thick held together by round half-inch iron bands. Each stave had to be meticulously curved, but no matter how well fitted, fine sand from the creek drifted in. Barrels and pipes required periodic flushing. (Some housewives hung fine sieves over their faucets to catch sand and an occasional small fish.)



▲ Redwood Standpipe

◀ Cherry Creek Galleries

In the winter of 1887, the company imported redwood from California at exorbitant freight rates to use for the sunken barrels. The 6 miles of pipes were half and half — Colorado pine for the bottom half because pine swells to fill cracks when saturated, California redwood which withstands alternate wetting and drying for the top half. These large pipes ended at 11th Avenue and Humboldt Street whence smaller pipes, all redwood, distributed water to the houses rapidly rising on the prairie. For the first four months of distribution, as reported in June 1887, the flow was nine million gallons a day; by the end of the year, it was four million.⁵

The water company carefully planned the reservoir, so even before they started to dig it, they erected a standpipe. This, according to the company reports, was for "surplus overflow and the escape of confined air, so as to retain as far as possible the reservoir pressure," and prevent "water hammer in the large mains from the reservoir into the city."

The standpipe rose 43 feet into the air, was 30 inches in diameter, was all of redwood and because the wind whipped across Cemetery Hill, was designed to withstand a pressure of 60 pounds per square foot. Perhaps that was not enough — perhaps a stronger wind blew it away. No record tells the date of its demise, but while it stood it must have been more visible from all over the town than its near neighbor, the abandoned pest house. The accurate minded historian may find out exactly where the standpipe stood by measuring 3984 feet east of 11th Avenue and Humboldt Street.

As the standpipe went up, the excavation for the reservoir went down to a depth of 17 feet. Horse drawn slips and scrapers flattened the top of the hill, then threw up banks, starting work September 1, 1887. Unexpectedly, the workers encountered large rocks, because of which the contractor collected an additional \$500. Although he had to handle "stiff adobe at the bottom" he finished the job in four months, excavating 17,480 cubic yards of earth, 21,060 cubic yards for the embankment.

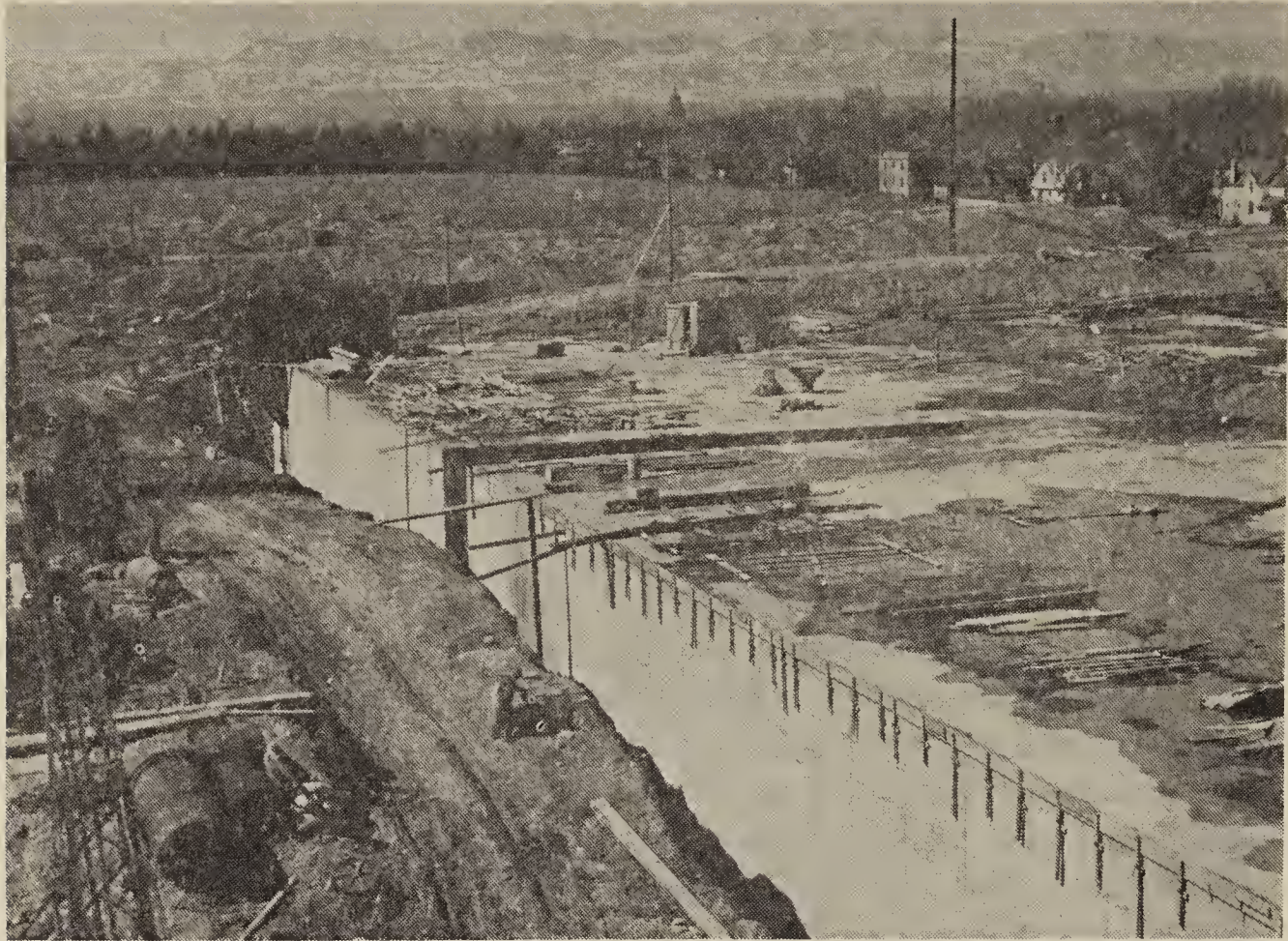
Water flowed into the reservoir in January 1888, and out again in April. The reservoir was drained because algae were forming in 12 to 14 feet of water, a problem unforeseen by the engineers. They set wooden posts in the bottom of the drained reservoir to support a wooden roof. The 73,272 square feet of roof cost \$5000, whereas a corrugated iron roof would have cost \$44,500. The company reported "all algae problems ceased when the sun was excluded."

The next winter, another problem arose! The roof threatened to collapse under the weight of snow. Men pushed snow through trapdoors into the water below. And in a few years the roof boards started to deteriorate, letting in not only the sun but stray dogs and confused birds to drown in the drinking supply.

Another problem was the flat taste. During the long trip from Cherry Creek the water in the mains grew stale. To aerate it, engineers built an apron, a weir box, and a weir where the pipe emptied the water into the basin.

Where the water left the basin, in 1888 the company erected a sturdy gate house (121 square feet) of stone with walls 16 inches thick, with a door, three windows, a shingle roof and — a pleasant Victorian touch for so utilitarian a building — "ornamental galvanized iron trim and hip shingles." From the gate house the water ran in a 20 inch main to 23rd Street to be distributed in all-redwood pipes.

With more householders demanding water every day, the company found that gravity could bring water to the Cemetery Hill reservoir but could not be depended on to deliver water to the houses. It installed a steam pump in 1891, and another in 1893. The pumps cost a lot and so did coal to fire the pumps, hauled in huge wagons pulled by draft horses.



Basin No. 1 was Rebuilt in 1948

In 1894, the Cemetery Hill problems became the problems of the Denver Union Water Company, Walter S. Cheesman, president. This most energetic monopoly re-built the 1891 pump and installed another in 1903, then turned its attention to finishing the great Cheesman Dam on the South Platte River, completed in 1905.

Capitol Hill Clear Water Reservoir #2. 1907.

In 1906, the company planned a second reservoir to serve East Denver, dropping the unappetizing name of Cemetery Hill for the Capitol Hill Clear Water Reservoir #2. This was to lie — and still lies — east of Basin #1, extending to the alley west of Detroit Street. When the neighbors heard of these plans, they complained, and who could blame them? Who wanted a view of a high dirt bank instead of a view of the Rocky Mountains? The all-powerful water company ignored their complaints, so the neighbors took the case to court, stating that the reservoir would constitute a public nuisance.⁶ Indeed not, decreed Judge Henry V. Johnson, ex-mayor of Denver, because Basin #2 was to be roofed over and covered with grass.⁷

Basin #2 was finished in 1907. It was longer than #1 and deeper — 22 feet instead of 17 — and had a capacity of 30 million gallons as against the 7 million of Basin #1. The roof was more than five times as big — 693,000 square feet. Of the 100,700 cubic yards of earth removed, 10,000 was shale rock. The waste was hauled 1000 feet. Was this the earth-fill the contractors found when they dug the foundation for 909 York Street, the present Denver Botanic Gardens house?

The attractive pump house, still used, that stands south of Basin #1 was also built in 1907, to house a new Worthington pump. The pump house was sturdily built of red brick, as was a new boiler house and a square smoke stack that measured 66 inches by 125 feet.

To fill both reservoirs the water main from Cherry Creek Galleries, which had been used unchanged (though often mended) since 1887, was relocated in 1908. Known as Conduit #5, the new route shortened the distance from 5.76 miles to 5.44

miles. Concrete pipes replaced the wooden ones and were not pre-fabricated but fashioned on the spot. Two years later this conduit was temporarily abandoned.⁸ When South Platte water first reached the Capitol Hill reservoirs it flowed through Conduit #6, a 48 inch main from the Wynetka Plant, a distance of 12.2 miles with a capacity of 26 million gallons a day. This treated water is purer than that merely filtered through the sands of Cherry Creek.⁹

Almost as soon as the Denver Union Water Company was formed in 1894, President Walter Cheesman wanted the city to buy it — at a price. After his death in 1906, David Moffat, the new president, needing money to build his railroad to Salt Lake, offered the improved system to the town — at a price. In 1913, Denver thought seriously enough about buying the company to hire the firm of Metcalf and Anderson, engineers, to inventory the system.

On Capitol Hill the firm reported an industrial complex, including a frame bunk house (22 by 22 feet) for employees. Also of frame were a pump house, a coal house, two water closets, and two tool houses. The office building was of brick as were the 1907 pump house, boiler house, and tall smoke stack. The report estimated that the complex delivered water over an area of 15 square miles. All other assets of the company were as meticulously detailed. Based on this report the city of Denver made an offer which the company laughed at.

In 1916, the price went up when the Denver Union Water Company made major improvements on Capitol Hill, including a centrifugal pump with a capacity of 10 million gallons, bought from the Worthington Pump Company for \$16,979. Because it was "necessary to construct a standpipe or serge (sic) pipe for the purpose of sustaining water pressure of this type of pump," the company hired the American Bridge Company to build a standpipe. Unlike the 1887 pipe built of redwood to a height of 45 feet, and unlike the 125 foot smoke stack built of brick, the new pipe was steel, 10 feet in diameter, and it rose 145 feet into the air. (It still does.)¹⁰ Like the two earlier pumps, the centrifugal pump was steam-driven. In order to facilitate the delivery and storage of coal, the company bought 1.26 acres of land from Congregation Emanuel at \$4000 an acre.

The City of Denver Buys The Water Company

Perhaps these improvements influenced the city of Denver in its 1918 decision to buy the water system, which included the underground galleries and cribs of Cherry Creek, the two reservoirs, three pumps, boiler and smoke stack, and the 145 foot surge pipe on top of Capitol Hill. The final transfer was staged at one minute past midnight on November 1, 1918.¹¹ This high drama was appropriate because the city had floated \$13,924,000 worth of bonds to pay the company. The newly formed Denver Board of Water Commissioners started the business of furnishing water to Denver with a working capital of \$424.

Basin #3. 1956

Bolstered by taxes, in 1948 the Commission could finance the enlargement of Basin #1, and by 1954 the building of Basin #3. This was needed to hold water supplied not only from the Kassler Filter Plant on the South Platte River, but also water from the Fraser River coming through the Moffat Tunnel under the Continental Divide. Basin #3 was to be a big reservoir, west of #1, but the city did not own enough land to build it. It needed land owned by Congregation Emanuel, inheritors of

the Hebrew Cemetery, so it bought all that remained of that graveyard, 8.7 acres, for \$40,000. This was a curved piece of land, its north-south line measuring 660 feet.

Before the reservoir was built, another decision had to be made — what to do about York Street? Straighten it? Widen it into four lanes? And then there was the stub of Josephine Street from the south, not connected with Josephine Street north of the cemetery. The solution was to keep the curve on York Street and make it a one-way street going south. Josephine, relocated, and curved, was to be a one-way street going north. The old stub of Josephine Street was retained for parking.

With these decisions made, Basin #3 was started. Modern equipment had no trouble moving 120,000 cubic yards of earth to form a basin 23 feet deep.¹² This basin and Basin #1 were roofed with concrete and an uninterrupted stretch of lawn covers them both, from which the view of the city and the mountains is magnificent. The Denver Botanic Gardens planted the west bank of Basin #3 as it curves along Josephine Street with bridal wreath bushes, which look like snow in early summer.

As each basin undergoes its periodic cleaning, water from it is pumped into the other two basins. The overflow from the reservoirs, if any, is carried directly to Cherry Creek in one pipe, to the city sewer system in another. The concrete lining of the three basins is practically leak-proof. Against any mishap to the Capitol Hill system, the Water Board carries heavy insurance.

According to a report by the Water Department on December 31, 1975, the three Capitol Hill reservoirs (Basin #3 on the west, 1956, Basin #1 in the middle, 1888, and Basin #2 on the east, 1907) at an altitude of 5395 feet above sea level, had a capacity of 80.2 million gallons of water, almost twice as large as the next largest distribution reservoir in the system, Ashland, 41 million gallons. The cash value of the Capitol Hill basins was \$2,864,800. Add to this the five electric pumps valued at \$486,300, and the five standby pumps in the brick building at about 1050 Elizabeth, built in 1975 and valued at \$788,400, and you have a four million dollar set up, a figure which would have staggered the men of 1887 who brought water by gravity from Cherry Creek to the top of Cemetery Hill.

NOTES

1. On January 30, 1978, 98 years after the first Archer building was erected, the Denver Water Department moved into its new headquarters near the three stone buildings at 12th Avenue and Shoshone.
2. On February 23, 1882, at a special city council meeting, "first steps were taken toward the construction of a reservoir on Cemetery Hill, to provide for irrigation on the new city park and fire pressure for points within the city having none." On November 14, the council granted free use of 20 acres of city-owned property to the Denver City Water Company for the purpose of constructing a 30 million gallon reservoir, with discharge and supply pipes, to be completed within nine months." Neither of these projects materialized. In 1884, the City Ditch began to water the new City Park, which it still does.
3. Anyone wishing to know the names of the various water companies — Denver had ten before the Denver Union Water Company took over in 1894 — may consult Smiley's *History of Denver* (1901) p. 793-808.
4. From 1887 to 1906, the water company paid the city of Denver \$9725 for rent on the 10 acres of land, plus an additional 40 square feet for the water tower. No further record of rent paid has been found in the Water Department books, despite the remark made by Lee Taylor Casey, who was usually accurate, in his January 3, 1950 column in the *Rocky Mountain News*. He reported that George Cranmer, head of the Department of Improvements and Parks in the 1940s, had "put the squeeze on the Water Department for \$150,000 back rent."
5. "Those who thought no water could be obtained from Cherry Creek would have been interested a few days ago in seeing the overflow from the supply pipe near the Hebrew Cemetery. It was necessary to let enough water go to waste there to supply a town of 5000 people." *Denver Times*, Nov. 14, 1887.

6. The lawyers of the Denver Union Water Company looked up the addresses of the people who brought the suit. One lived at 1056 Detroit, another at 1144 Detroit, three in the 1100 blocks of Clayton and Fillmore; four lived south at 413 and 523 Josephine, 321 Detroit and 412 Milwaukee; and one lived at 32nd and Curtis. (The ones on the south feared the reservoir would break.) The lawyer got affidavits from nearer neighbors who were not worried about danger from the reservoir, nor did they consider it a public nuisance.
7. Despite Judge Johnson's promise that Basin #2 would be sodded over, it is the only one of the three basins that is not. Today Basin #2 is roofed with Oregon fir, "beautiful Oregon fir with no eyes or blemishes," as one of the men who installed it said. Fearing sod would be too heavy for the fir, the engineers covered the wood with tar and gravel.
8. As late as May 1958, the country surrounding the Cherry Creek Galleries, which were a few blocks down stream (north) of the Iliff Avenue bridge, was so open that a fox and her kits lived in a den in the bank. By 1977, industries had closed in, the water was contaminated by a nearby dump and contained iron and manganese. That and the fact that Cherry Creek water has a hardness of 290 as against 40 for the South Platte water, forced the closing of the Cherry Creek Galleries, after 90 years of faithful service.
9. The improved purity of Denver water was proved by 1912 when only 31 deaths from 499 cases of typhoid fever occurred.
10. The coal house, smoke stack, and stand pipe were no longer needed when the pumps were electrified, starting in 1927. The smoke stack was demolished and the standpipe disconnected from the water system. The Denver Police Department now uses the standpipe for its radio antennas. Painted in red and white bands, the standpipe now carries the call number KAA 511.
11. Certain families kept tight control of water companies in Denver — Cheesman, Moffat, Evans, Kassler. Walter Cheesman, a director in Archer's 1870 company, was the water mogul of Denver when he died in 1906. His son-in-law, John Evans II, was chairman of the Board of the Denver Union Water Company when the city bought it in 1918. George W. Kassler, banking associate of Moffat, was treasurer of the company that built the first Cemetery Hill reservoir in 1887; his son, Edward S. Kassler, as president of the Denver Union Water Company, signed the transfer to the city at the midnight ritual in 1918.
12. The Department of Parks and Improvements trucked the earth from Basin #3 to the old Robinson brickyards at 3rd Avenue and Forest Street to turn that eyesore into present Robinson Park.



Basin No. 1 was Drained in 1916

Denver Orchid Collectors

Beatrice F. Thurston
& William R. Thurston

One mile above sea level, freezing winds up to 80 miles per hour, temperature below 0 degrees F. several days of the year, and an average precipitation of less than 12 inches — a high, cold, windy desert — this is Denver, Colorado. It certainly is a very unlikely place for a botanically significant collection of a plant family usually considered to be tropical in origin. Perhaps, but Denver is also uniquely endowed with dozens of dedicated orchid enthusiasts; the Denver Orchid Society membership is now over 250 and our Denver Botanic Gardens has an excellent staff whose duties include the care and culture of these temperamental denizens of more hospitable climes.

Inventory of the Botanic Gardens collection in January, 1978 revealed 1,189 orchid plants alive and well under the care of Larry Latta in the greenhouses and conservatory. Over 250 of these are "man made" hybrids in the *Cattleya* alliance or the genera *Cymbidium*, *Phalaenopsis*, and *Paphiopedilum*. Slightly fewer than 400 are species orchids collected within the political boundaries of Mexico. For a "high, cold, windy desert" this is quite an accomplishment since no more than 700 species have ever been identified in

An oil geologist, Mr. Thurston, and a micro-biologist, Mrs. Thurston, are actively engaged in locating and collecting Mexican orchids on a vacation-time basis. Of those plants that they have brought to the Denver Botanic Gardens, 374 are still flourishing.

Mexico and more than half now make their home in Denver. The Botanic Gardens orchid collection, though in its infancy (no area specifically for orchid culture was even dedicated until 1975), has worldwide representation: from A to Z; *Angraceum* from Madagascar, *Ansellias* from Africa, *Acriopsis* from Java, *Vandas* from Southeast Asia and *Zygopetalums* from Brazil.

Almost all of this material has been made available to the Botanic Gardens in the last five years and by the generous donations of 15 individuals. Significantly, in two cases, the Denver Botanic Gardens was selected as repository for the orchid material by the family and friends of a deceased collector. Mr. Walter Slagle, president of the American Orchid Society from 1962 to 1964 and a renowned orchid grower, was a longtime resident of Denver. In 1974 after his death, much of his collection and his substantial orchid library were kindly donated to the Denver Botanic Gardens by his secretary, Mrs. Grace Barger. Several of his outstanding hybrids are often seen in the Helen Fowler Library or the Lobby Court display. A number of years ago, Mr. Slagle sent a flower of an exceptionally fine clone of *Laelia cattleya* 'Walter Winchell' to Rod McClellen, an orchid grower in California. McClellen used its pollen in a cross that eventually produced a progeny receiving many awards named *Lc.* 'Walter Slagle.' McClellen also used the same *Lc.* 'Walter Winchell' pollen to produce a second cross later



Orchid Collectors: L. to r. Beatrice F. Thurston, Kas Berzins, Gary Davis, Larry Latta.

named in honor of Mr. Slagle's daughter, Suzanne Fullerton (Mrs. Paul), a longtime Denver resident. Excellent clones of the parent *Lc.* 'Walter Winchell Slagle' and the progeny *Lc.* 'Suzanne Fullerton' and *Lc.* 'Walter Slagle' are included in the Botanic Gardens collection.

Mrs. Roger B. Mead, a prominent Denver native, had selected an outstanding collection of hybrid and species orchid material from all over the world. At her death in 1976, her son, William I. Mead, approached the Botanic Gardens staff about the possibility of keeping the collection intact. The gift was gratefully accepted, and now available in the Denver Botanic Gardens collection are her clones of the magnificent *Anguloa cliftonii* Rolse from Columbia, *Catasetum serratum* Lindl. of Panama, *Oncidium splendidum*, A. Rich ex Duch., *Oncidium tigrinum* Hart ex Lindl., *Oncidium varicosum* Lindl. var

rogersii, several spectacular *Cattleya* hybrids and a number of beautiful *Paphiopedilum* crosses.

The generosity of several other collectors is also gratefully acknowledged. Mrs. J. H. Silversmith, finding her new home not properly equipped to care for her excellent hybrid collection, felt that perhaps greater benefit for more people would be available at the Botanic Gardens. In 1977, her outstanding *Cattleya* crosses, *Brassauola leila cattleya* 'Pablo', *Brassauola leila cattleya* 'Living Gold', *Sophranotis brassauola leila cattleya* 'Carousel', *Sophranotis leila cattleya* 'Jewel Box Scheherazade,' to mention a few, and several elegant *Paphiopedilum* and *Phalaenopsis* joined the Botanic Gardens collection. The previous year, another longtime resident and serious collector, Mrs. Norman Cohn, also contributed the majority of her excellent hybrid *Cattleya* collection, several fine *Cymbidiums* and *Dendro-*

biums and *Phalaenopsis* crosses as well. The Botanic Gardens was also very fortunate in receiving the Haberstroh collection from Ft. Collins in 1974. Over 90% of the spectacular and showy *Cattleya* alliance material often on display in the Botanic Gardens has come from these five individuals. Not only is our high, windy desert fortunate in its donations of excellent *Cattleya* hybrid material, but a number of fine *Cymbidium* crosses have been contributed by Mr. and Mrs. William Miles who adopted Denver as their home four years ago. Denver native, Mr. Ed Horton, has also added significantly to the *Phalaenopsis* hybrid material.

A Botanic Gardens must function actually in two major capacities, first to supply a pleasing display of blooming plants and foliage material to provide an esthetically enjoyable experience for the general public; and second, to be a source of living plant material for the study and dissemination of botanical knowledge. Our Denver Botanic Gardens orchid collection is now slowly acquiring the means to fulfill the second objective. In the last 125 years, only a small handful of cities or universities has been the repository for significant collections of living species orchid material.

Plans currently being made here will almost certainly result, in the course of a few years, in the establishing of more adequate room for growing and displaying many genera and species not now available for the public to see. We are now well on our way in certain areas of collection of orchid material, Mexican and Colombian species in particular.

Dr. George Kennedy of the University of California at Los Angeles, author of numerous articles on species orchids, has made several excellent gifts to the Botanic Gardens collection. In 1972, our first Asian species as well as several Central American representatives were donated by Dr. Kennedy. Since that time, Dr. Kennedy has always been most

generous in sharing his material with Denver after each of his exciting trips collecting in various parts of the world. The latest contribution was in 1977 from the high mountains of Columbia. As many as 40 species new to our collection will probably flower in the next few months. One exceptionally fine specimen of *Oncidium machranthum* Lindl. has just opened. This plant surely would catch the eye even when displayed with the bright *Cattleya* hybrids. Its dozens of large, brown flowers with striking white lip are quite spectacular.

A Collector's Life

Our own contribution to the education resources of the Botanic Gardens began very innocently in 1972 when, not really knowing an orchid from a bromeliad in nature, we obtained a permit from the Department of Agriculture to import various tropical plants. We were planning our first trip to Mexico and thought there might be a chance of sighting an orchid or two and that it was well to be prepared with the proper documents. Little did we know that we were embarking on a journey of total involvement with a related, contagious, but readily identifiable disease known as "orchidiosis." Each year since, we have felt the urge to make the *hegira*, not to Mecca, but to Mexico in search of some new orchid material. We load camping gear, camera equipment and 24 feet of pruning pole adapted for orchid collecting into a rented Volkswagen in Mexico City or Oaxaca and literally "head for the hills." The majority of the orchids are located at altitudes between 1,000 and 2,500 meters in pine-oak forests and are usually growing epiphytically. We have collected, however, from the sheer rock faces of great canyons, in soggy, dense, tropical vegetation with orchids on downed tree trunks floating in rivers as well as in the driest of acacia thorn

woods where even a goat has a hard time foraging. As each clone is collected, it is carefully labeled as to exact locale and altitude, a record is kept in a field journal and identification is attempted as nearly as possible, though many times when a plant blooms months later in the greenhouse we find an unusual surprise. One unique event was the blooming of an unidentified species of *Encyclia* we had collected in 1973 in the state of Vera Cruz. We returned to the locale in 1975 with our friend Dr. John Stewart of Denver, found a new, paved road, but also several examples of this confusing plant in bloom. Subsequently, with the aid of Leslie Garay, curator of the Oakes Ames Herbarium at Harvard and our friend and mentor in Oaxaca, Glenn Pollard, we identified *Encyclia flabellata* Lindl., first collected in 1838 and never found again.

We have been accompanied on several of our adventures by other hardy and delightful friends — Mr. and Mrs. Edward Horton, Larry Latta and Gary Davis of the Denver Botanic Gardens staff, Mrs. Henry Northen (Rebecca), orchidologist and world famous author, and Eric Hagsater, curator of the Orchid Herbarium in Mexico City. Often, the expeditions lead us literally to the "end of the road" and we find ourselves making camp in the most unusual places, invariably after dark. Dr. John Stewart holds the prize, though, for collecting 12 different species by flash-light from fallen trees at a hair-raising turn, the only wide spot in the road, where we pitched our tent an hour after dark. We found the next morning, much to our chagrin, that the road was under construction and closed entirely to all traffic from dawn to dark. Someday we must return when the road is finished and find out what interesting material is just over the next hill.

During our several expeditions into the wilds, we have never felt particularly concerned about our safety — camping in Indian country is generally very secure — except when we inadvertently wandered into heroin poppy country in Nayarit. There our cheery "buenas dias" were met with cold stares; and a second time when the Federales Fiscal agent thought these "crazee gringos" with plant material stuffed in every corner of their VW beetle must also be hiding some marijuana. In both cases though, prudent explanation or the proper Mexican governmental documents — stamped profusely with green ink — explained our purpose. One difficulty arose though when it became obvious that the Fiscal agent could not read Spanish, let alone English. Over 70% of the population in Mexico is pure Indian from as many as 200 tribes and many speak only their own dialect and virtually no Spanish. This agent apparently was impressed with the official nature of our quest, however, and eventually allowed us to proceed — to make camp after dark, again!

It has been our pleasure and now is our most consuming avocation to try to provide the botanic community of Denver and the general public as well, with the most complete collection of living orchidaceous material from south of the border. We are also preparing a complete photographic record eventually to be housed in the Helen Fowler Library, to aid any student in the identification of wild material. We hope, with the completion of the orchid-bromeliad facilities in the near future, all of this material will be accessible to the serious student and layman alike. The world of orchidacea is a most fascinating one and we all enjoy sharing its beauty, especially here in the "high, cold, windy desert" where cultural conditions are always a challenge.



The Thurstons in the Field

Plant Study on Mount Goliath

Jeanette Hartman

There are many excellent studies of alpine vegetation in North America. Alpine research in Colorado, however, has been limited. This is unfortunate, in that there are many fine such areas in Colorado. Information concerning alpine vegetation is particularly important now, with increased usage of these areas, both by motor vehicles and by foot travel.

Mount Goliath Research Natural Area provides an excellent opportunity to study alpine flora. From early June through August, there is a diverse and colorful carpet of flowers extending as far as the eye can see. The area is located about 25 miles west of Denver, Colorado. It ranges in altitude from 11,000 feet to 12,215 feet. The major topographic feature is Mount Goliath, where most of the data for this project were collected.

Mount Goliath Research Natural Area was created primarily to preserve a significant stand of the ancient bristlecone pine *Pinus aristata* Engelm. It has also served the purpose of preserving an excellent example of alpine vegetation under the provisions of a federal research natural area. There are only four other natural areas in Colorado, none of which contains alpine community types.

There is easy access to the area in the summer months. Colorado state highway 103 approaches the north and west borders. The natural area is bisected by the M. Walter Pesman Trail, which is maintained by the Denver Botanic Gardens and the U.S. Forest Service. The trail provides for easy hiking through the area and also protects the delicate alpine flowers which, when once destroyed, may take decades to be replaced.

In this study, samples of all the flowering plants were taken and identified. These are recorded in the checklist. Specimens of each plant are in the Colorado Women's College herbarium. Two other pieces of information are important in determining the makeup of a plant community. One is the percent-frequency of a plant. This tells how frequently a plant occurs in the area. A high number for the percent-frequency means that the plant occurs often throughout the area. The other is percent-cover. This tells how much of the ground is covered by a plant. For instance, a rose bush covers more of the ground than a tulip, although they are each just one individual plant. Here again, a high number for percent-cover means that the plant covers quite a bit of ground. To obtain this information, a metal frame, called a Daubenmire frame, was used. The frame is sectioned in such a way that percent-cover and percent-frequency for each plant can be easily measured, if repeated frame readings are made in an area. The natural area was divided into four smaller areas, and percent-cover and percent-frequency were determined for each plant in each area. The four areas can be seen in Fig. 1, and the results can be seen in Table 1.

Ninety-four species, in 24 different families, were identified in this study. Several

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of the plants found on Mount Goliath are common alpine plants elsewhere in the United States. *Lloydia serotina* L. (alpine lily) and *Silene acaulis* L. (moss campion) are found even in the polar regions. It is said that they originated in the arctic regions and migrated to lower areas with the glaciers during the ice age.

Exposure differences had a definite effect on the type of plant growing on Mount Goliath. A comparison of the east- and west-facing slopes, areas 2 and 4, respectively, revealed that out of 66 total species, the two areas had only 15 species in common (Table 2).

In general, most plants in Mount Goliath Research Natural Area flowered in June. The Cyperaceae, or sedge family, tended to mature late in the season, while the Primulaceae, or primrose family, matured earlier in the season than most families.

Without regard to the part of the summer in which you visit Mount Goliath Research Natural Area, you will have an experience of such beauty and exhilaration that you will not forget it for a long, long time.

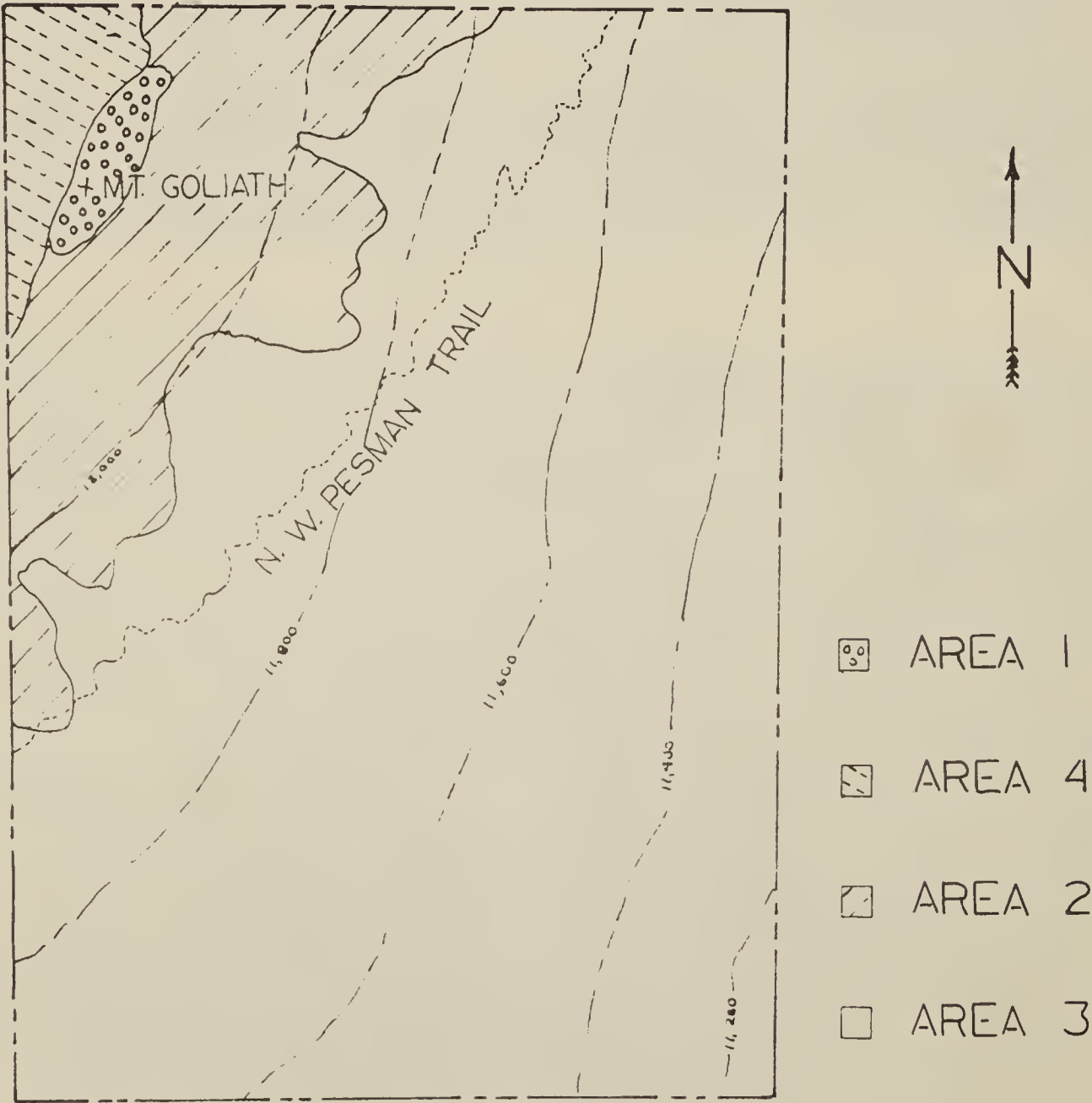


FIG. 1
MT. GOLIATH RESEARCH NATURAL AREA

Table 1. Percent-cover (first number), percent-frequency (second number) figures.
Common names and authors for plants can be found in the checklist. +
represents a statistic of less than one.

Species	Area 1	Area 2	Area 3	Area 4
<i>Arenaria obtusiloba</i>	32-88	11-36	+3	18-58
<i>Trifolium dasyphyllum</i>	17-48		7-25	21-59
<i>Polygonum bistortoides</i>	+4			2-14
<i>Paronychia pulvinata</i>	13-44			16-40
<i>Geum rossii</i>	12-40	10-29		13-41
<i>Silene acaulis</i>	2-8			4-21
<i>Arenaria fendleri</i>	1-8	1-4		7-16
<i>Artemisia scopulorum</i>	9-44	9-34		9-37
<i>Chrysopsis villosa</i>	3-12	14-41	13-46	3-13
<i>Artemisia borealis</i>	1-8	8-21		
<i>Phlox caespitosa</i>	+4	+1		
<i>Luzula spicata</i>		2-9		2-6
<i>Androsace carinata</i>		2-9		+2
<i>Saxifraga rhomboidea</i>		+1	+2	+2
<i>Calamagrostis purpurascens</i>		+1		2-5
<i>Polemonium viscosum</i>		11-43	1-3	2-7
<i>Achillea lanulosa alpicola</i>		12-53	10-43	
<i>Sedum stenopetalum</i>		9-37	2-12	
<i>Penstemon whippleanus</i>	+2	+3	+3	
<i>Allium geayeri</i>		1-7	+1	
<i>Hymenoxys acaulis</i> var. <i>caespitosa</i>		2-12		2-9
<i>Antennaria parvifolia</i>		+3	1-7	
<i>Potentilla fruticosa</i>		4-16		
<i>Potentilla diversifolia</i>		5-23		
<i>Mertensia franciscana</i>		2-9		
<i>Eriogonum flavum</i>		+1		
<i>Cirsium scopulorum</i>		3-7		
<i>Carex</i> sp.		+4		
<i>Poa rupicola</i>		+1		
<i>Erigeron simplex</i>		+1		
<i>Carex</i> sp.		+1		
Species	Area 1	Area 2	Area 3	Area 4
<i>Aquilegia caerulea</i>		2-8		
<i>Senecio integerrimus</i>		1-4		
<i>Carex elynoides</i>	2-8	11-35		3-8
<i>Hierochloe odorata</i>		+1		
<i>Aquilegia</i> sp.		1-4		
<i>Trifolium parryi</i>		4-48		
<i>Aster foliaceus apricus</i>		2-9		
<i>Agropyron scribneri</i>		1-8		5-17
<i>Agropyron trachycaulum</i>		+4		
<i>Festuca ovina</i> var. <i>brachyphylla</i>	+4	5-24		4-20
<i>Arabis drummondii</i>			1-9	
<i>Erysimum nivale</i>			+1	

<i>Machaeranthera pattersonii</i>			+1	
<i>Deschampsia caespitosa</i>	+4	14-41	18-61	6-20
<i>Campanula rotundifolia</i>		2-11		
<i>Eritrichium elongatum</i>	+4	+1		
<i>Poa sandbergii</i>			1-8	
<i>Senecio pudicus</i>			+3	
<i>Artemisia campestris</i>			4-10	
<i>Penstemon</i> sp.			4-21	
<i>Potentilla rubricaulis</i>			+3	
<i>Senecio werneriaefolius</i>			+1	
<i>Androsace septentrionalis</i>				
<i>puberulenta subumbellata</i>		+1	1-3	
<i>Trisetum spicatum</i>		+4	3-12	
<i>Draba</i> sp.			+3	+3
<i>Epilobium angustifolium</i>				+4
<i>Claytonia megarrhiza</i>				+1
<i>Sedum rhodanthum</i>				+4
<i>Potentilla concinna</i>				2-5
<i>Haplopappus pygmaeus</i>				2-6
<i>Draba aurea</i>				+4
<i>Castilleja puberula</i>				+1
<i>Lloydia serotina</i>		2-8		

Table 2. Comparison of east- and west-facing slopes of Mount Goliath.

Plants Occurring in Area 2 Only

- Potentilla fruticosa* (shrubby cinquefoil)
- Sedum stenopetalum* (yellow stonecrop)
- Artemisia borealis*
- Achillea lanulosa alpicola* (yarrow)
- Allium geayeri* (Geyer onion)
- Potentilla diversifolia* (cinquefoil)
- Campanula rotundifolia* (alpine harebell)
- Trifolium parryi* (Parry clover)
- Mertensia franciscana* (chiming bells)
- Eritrichium elongatum* (forget-me-not)
- Phlox caespitosa* (alpine phlox)
- Eriogonum flavum* (umbrella plant)
- Cirsium scopulorum* (Hooker thistle)
- Poa rupicola* (timberline bluegrass)
- Lloydia serotina* (alpine lily)
- Androsace septentrionalis puberulenta*
 var. subumbellata (rock primrose)
- Penstemon whippleanus* (dusky penstemon)
- Erigeron simplex* (daisy)
- Aster foliaceus var. apricus* (aster)
- Antennaria parvifolia* (pussytoes)
- Senecio integerrimus* (senecio)
- Agropyron trachycaulum* (wheatgrass)
- Hierochloe odorata* (sweetgrass)

Plants Occurring in Area 4 Only

- Trifolium dasyphyllum* (alpine clover)
- Sedum rhodanthum* (rose crown)
- Potentilla concinna* (elegant cinquefoil)
- Polygonum bistortoides* (bistort)
- Silene acaulis* (moss campion)
- Epilobium angustifolium* (fireweed)
- Haplopappus pygmaeus* (goldenweed)
- Paronychia pulvinata* (nailwort)
- Claytonia megarrhiza* (spring beauty)
- Draba aurea* (whitlow-grass)
- Castilleja puberula* (paintbrush)
- Arabis drummondii* (rock cress)

A CHECKLIST OF PLANTS FOUND IN MOUNT GOLIATH RESEARCH NATURAL AREA

Date of Flowering

Family: Boraginaceae (borage)	
<i>Mertensia franciscana</i> Heller. (chiming bells)	8-29
<i>Mertensia viridis</i> A. Nels. (chiming bells)	6-11
<i>Eritrichium elongatum</i> (Rydb.) Wight (forget-me-not)	6-11
Family: Campanulaceae (bellflower)	
<i>Campanula rotundifolia</i> L. (alpine harebell)	8-25
Family: Caryophyllaceae (pink)	
<i>Arenaria fendleri</i> A. Gray. (Fendler sandwort)	6-19
<i>Arenaria obtusiloba</i> (Rydb.) Fernald. (sandwort)	6-11
<i>Cerastium beeringianum</i> Cham. & Schlecht. (pink)	6-11
<i>Paronychia pulvinata</i> Gray (nailwort)	8-29
<i>Silene acaulis</i> L. (moss campion)	6-19
Family: Compositae (sunflower)	
<i>Achillea lanulosa alpicola</i> Nutt. (yarrow)	6-28
<i>Antennaria microphylla</i> Rydb. (pussytoes)	6-28
<i>Antennaria parvifolia</i> Nutt. (pussytoes)	6-28
<i>Antennaria rosea</i> (D. C. Eat.) Greene (pink pussytoes)	7-2
<i>Arnica latifolia</i> Bong.	6-24
<i>Artemisia borealis</i> Pallas	8-29
<i>Artemisia campestris</i> L.	
<i>Artemisia scopulorum</i> A. Gray	8-25
<i>Aster foliaceus</i> var. <i>apricus</i> Lindl. (aster)	7-11
<i>Chrysopsis villosa</i> Pursh (hairy golden aster)	7-2
<i>Cirsium scopulorum</i> Greene (Hooker thistle)	7-2
<i>Erigeron peregrinus</i> Pursh (daisy)	
Family: Crassulaceae (orpine)	
<i>Sedum integrifolium</i> (Raf.) A. Nels. (king's crown)	6-19
<i>Sedum rhodanthum</i> A. Gray (rose crown)	6-19
<i>Sedum stenopetalum</i> Pursh (yellow stonecrop)	7-2
<i>Erigeron simplex</i> Greene (daisy)	8-29
<i>Haplopappus pygmaeus</i> T. & G. (goldenweed)	6-11
<i>Hymenoxys acaulis</i> var. <i>caespitosa</i> A. Nels. (woolly actinea)	
<i>Hymenoxys grandiflora</i> T. & G. (old man of the mountain)	7-31
<i>Machaeranthera pattersonii</i> (A. Gray) Greene (aster)	7-31
<i>Senecio fremontii</i> T. & G. var. <i>blitoides</i> (Greene)	
Cronquist (senecio)	6-24
<i>Senecio integerrimus</i> Nutt. (senecio)	8-29
<i>Senecio pudicus</i> Greene (senecio)	7-2
<i>Senecio werneriaefolius</i> A. Gray. (senecio)	7-2
<i>Solidago spathulata</i> DC (goldenrod)	
Family: Cruciferae (mustard)	
<i>Arabis drummondii</i> A. Gray (rock cress)	6-19

<i>Cardamine cordifolia</i> A. Gray (bittercress)	7-2
<i>Draba aurea</i> M. Vahl. (whitlow-grass)	6-11
<i>Erysimum amoenum</i> (Greene) Rydb. (alpine wallflower)	6-5
<i>Erysimum nivale</i> (Greene) Rydb. (alpine wallflower)	6-5
Family: Gentianaceae (gentian)	
<i>Gentiana calycosa</i> Griseb. (mountain gentian)	7-31
<i>Gentiana prostrata</i> Haenke. (gentian)	7-31
Family: Graminae (grass)	
<i>Agropyron scribneri</i> Vasey (wheatgrass)	8-25
<i>Agropyron trachycaulum</i> Link (wheatgrass)	7-31
<i>Calamagrostis purpurascens</i> R. Br (reedgrass)	6-24
<i>Deschampsia caespitosa</i> L. (hairgrass)	8-29
<i>Festuca ovina brachyphylla</i> L. (fescue)	7-31
<i>Hierochloe odorata</i> (L.) Beauv. (sweetgrass)	8-29
<i>Poa rupicola</i> Nash (timberline bluegrass)	6-11
<i>Poa sandbergii</i> Vasey (bluegrass)	8-29
<i>Trisetum spicatum</i> L. (trisetum)	6-24
Family: Hydrophyllaceae (waterleaf)	
<i>Phacelia sericea</i> Graham (purple fringe)	6-24
Family: Juncaceae (rush)	
<i>Luzula spicata</i> (L.) DC. (woodrush)	7-31
Family: Leguminosae (pea)	
<i>Trifolium dasyphyllum</i> T. & G. (alpine clover)	6-5
<i>Trifolium parryi</i> Gray (Parry clover)	6-24
Family: Liliaceae (lily)	
<i>Allium geyeri</i> Wats. (Geyer onion)	6-28
<i>Lloydia serotina</i> L. (alpine lily)	6-11
Family: Onagraceae (evening-primrose)	
<i>Epilobium angustifolium</i> L. (narrow-leafed fireweed)	7-2
Family: Polemoniaceae (Phlox)	
<i>Phlox caespitosa</i> Nutt. (alpine phlox)	6-5
<i>Polemonium delicatum</i> Rydb. (Jacob's ladder)	6-11
<i>Polemonium viscosum</i> Nutt. (sky pilot)	6-5
Family: Polygonaceae (buckwheat)	
<i>Eriogonum flavum</i> Nutt. (umbrella plant)	8-25
<i>Polygonum bistortoides</i> Pursh (bistort)	6-11
Family: Portulacaceae (purslane)	
<i>Claytonia megarrhiza</i> (Gray) Parry (big-rooted spring beauty)	8-29
<i>Lewisia pygmaea</i> A. Gray (least lewisia)	6-19

Family: Primulaceae (primrose)	
<i>Androsace carinata</i> Torr. (rockjasmine)	6-11
<i>Androsace septentrionalis</i> L. <i>puberulenta</i> (Rydb.) Knuth. var. <i>subumbellata</i> (rock primrose)	6-5
<i>Primula angustifolia</i> Torr. (fairy primrose)	6-19
Family: Ranunculaceae (buttercup)	
<i>Aquilegia caerulea</i> James (columbine)	6-28
<i>Aquilegia caerulea</i> var. <i>ochroleuca</i> Hook. (columbine)	6-28
<i>Caltha leptosepala</i> DC (marsh marigold)	7-2
<i>Ranunculus pedatifidus</i> J. E. Smith (bird-foot buttercup)	6-24
<i>Trollius laxus</i> Salisb. (globeflower)	7-2
Family: Rosaceae (rose)	
<i>Fragaria ovalis</i> (Lehm.) Rydb. (wild strawberry)	6-24
<i>Geum rossii</i> (R. Br.) Ser. (alpine avens)	6-5
<i>Potentilla concinna</i> Richards (elegant cinquefoil)	6-11
<i>Potentilla diversifolia</i> Lehm. (cinquefoil)	6-11
<i>Potentilla fruticosa</i> L. (shrubby cinquefoil)	6-28
<i>Potentilla rubricaulis</i> Lehm. (cinquefoil)	8-29
Family: Salicaceae (willow)	
<i>Salix brachycarpa</i> Nutt. (Canada willow)	6-11
Family: Saxifragaceae (saxifrage)	
<i>Heuchera bracteata</i> Torr. (alumroot)	7-31
<i>Saxifraga rhomboidea</i> Greene (snowball saxifrage)	6-5
Family: Scrophulariaceae (figwort)	
<i>Castilleja puberula</i> Rydb. (paintbrush)	7-31
<i>Castilleja rhexifolia</i> Rydb. (rosy paintbrush)	6-24
<i>Pedicularis parryi</i> A. Gray (lousewort)	7-2
<i>Penstemon whippleanus</i> A. Gray (dusky penstemon)	6-19
<i>Veronica wormskjoldii</i> Roem. & Schult. (alpine speedwell)	6-28
Family: Umbelliferae (carrot)	
<i>Angelica grayi</i> Coulter & Rose (Gray's angelica)	7-2
<i>Oreoxis alpina</i> (A. Gray) Coulter & Rose (alpine parsley)	6-5
<i>Pseudocymopterus montanus</i> (A. Gray) Coulter & Rose (mountain parsley)	6-28
Family: Valerianaceae (valerian)	
<i>Valeriana edulis</i> Nutt.	6-24

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Our Gardens Should Have The Blues

Maud McCormick

From the first crocus until the last chrysanthemum there is plenty of yellow and orange in the garden. Usually there is also a profusion of pink and red tones. Purple and lilac and lavender, too, are not hard to find. True blue is a little harder to come by. But it is worthwhile to spend a little time and study on the problem of making the flower borders reflect the brilliance of our Colorado skies.

In the spring there is the tiny clear-blue forget-me-not (*Myosotis scorpioides* L.) as well as its coarser associates *Anchusa azurea* Mill. v. 'Dropmore' and 'Royal Blue'. *Polemonium*, (Jacob's ladder) and *Baptisia* (blue false indigo), too, lift their blue spikes a little higher. Many veronicas are blue in effect though some have a lavender tinge. Most notable are Royal Blue, Crater Lake Blue, Blue Spire, Blue Champion and Sunny Border Blue.

Linum perenne L., the fairy flax, makes misty mounds that faithfully reflect the clear summer skies, and two campanulas, *Persicifolia* 'Telham Beauty' and the double 'Misty Morn,' furnish spires of the same color for a greater part of the summer. The hardy pin-cushion flower, *Scabiosa caucasica* Bieb., as well as the Blue Giant cupid's dart (*Catananche caerulea* L.) and Mountain Bluet (*Centaurea montana* L.), are other summer favorites. Later the platycodons take their place and the perennial blue *Salvia azurea* Lam. v. *grandiflora* lifts tall spires above the autumn border, while leadwort (*Ceratostigma plum-baginoides* Bunge) spreads its gentian blue above a deep green carpet.

Miss McCormick was an excellent gardener in the English tradition and was a frequent contributor to *The Green Thumb* magazine in its young years. Basically this article is a revision of her original article published in March 1952 and another, November 1944.

Two of our noblest perennials, however, contribute the most effective masses of blue. Clear blues of varying intensity have been, to my thinking, the greatest contribution of the iris hybridizers in recent years. Where will you find anything more exquisite in May? *Iris* 'Babbling Brook' and 'Millrace' are deep sky blue; Skywatch and Sapphire Hills are light blue; Blue Reflection and Blue Lustre are of medium intensity and Shipshape and Praise the Lord represent navy.

Later, and repeating in the autumn, are the delphiniums, tallest and most striking spires in the garden. In groups of threes at the back of the border, the fine double Pacific hybrids make an unforgettable picture in any color — purple, rosy lavender, shining white, or pink as well as their original tones of blue. But if they came only in the soul-thrilling blue of the variety so rightly named Summer Skies, they would still be the best tall flower in our gardens. Blue Bird is among the best of medium blues.

A word of caution — a plant tucked away in the northwest angle of a building surrounded by other tall-growing perennials, over-fertilized and over-watered, will give a very poor account of itself, if it does not die outright. It needs light and air as much as does a peony or a rose. Robbed of these two requirements, it cannot be expected to grow tall and blue. Use Rocky Mountain columbine, blue phlox, Virginia bluebells or other shade-lovers in such a location and still have plenty of Colorado's brilliant blue.

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Focus on

Jacaranda acutifolia

in the Boettcher Memorial Conservatory

Peg Hayward

One of the most beautiful trees in the tropics and semitropics is the jacaranda. One sees so many bright warm colors in the tropics that the cool violet-blue of this tree is a welcome sight.

Fifty species of trees and shrubs belonging to the genus *Jacaranda*, Bignonia family, are natives of Central and South America and the West Indies; most are Brazilian. The best-known kind, *Jacaranda acutifolia* Humb. & Bonpl., has been introduced into most warm countries and planted for ornament. Even the common name, jacaranda, is seldom pronounced correctly. It comes from Brazil, where the literates speak largely Portuguese, and in that language the letter "j" is pronounced like the "z" in "azure," and in this word the last vowel is accented.

This Brazilian tree attains a height of about 50 feet and requires as much space in which to spread. The foliage, finely cut as a fern, is symmetrical and elegant. The compound leaves are up to 15 inches in length, and divided and sub-divided into tiny leaflets. The fern-like leaf canopy drops in mid-winter and then gradually thickens when the main show of flowers is gone.

The jacaranda presents a spectacular display in full bloom. Violet-blue flowers, which appear in large, loose clusters at the ends of the branches, are

Mrs. Hayward has been active at Denver Botanic Gardens for many years. She has been a leader in the preparation of *The Conservatory Guide* and in the training of guides. Her article "Focus on" has been a feature of many issues of *The Green Thumb*.

shaped like bells. Each narrowly bell-shaped, five lobed flower is about 2 inches long. Clusters of flowers on the leafless branches all over the tree make the jacaranda an intense mass of color and one of the showiest of flowering trees. The flowers fall easily and there is always an attractive mauve carpet beneath the tree during the flowering period. Blooming time is erratic but is most often in spring and usually again in August. Distinctive seed pods are flat, wavy-edged discs about 2 inches in diameter and contain many two-winged, thin brown seeds.

Jacaranda being highly ornamental even when not in flower is used on a wide scale for planting in almost all Brazilian cities. It is widely grown in Southern Africa and at one time 45,000 jacaranda trees were planted in the city of Pretoria, which has become world-famous for its jacaranda lined streets making a blue haze over the city and attracting many visitors to its annual jacaranda festival.

Some curative properties have been attributed to the jacaranda. The Indians of Brazil use the leaves; in Panama, the bark is used for skin diseases. The natives of Venezuela and Colombia use it for medicine.

Jacaranda acutifolia is in the Boettcher Memorial Conservatory collection. Perhaps some of you had the opportunity to see a small jacaranda blooming in the Lobby Court display this Spring.

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Jacaranda acutifolia Humb. & Bonpl.▲

▼ *Aquilegia caerulea* James



We Are Sorry

for errors of editing which appeared in the Spring 1978 issue:

Mr. William J. Lunsford is Treasurer for the Board of Trustees of the Denver Botanic Gardens, not Mr. Alexander L. Kirkpatrick.

The headline for the article on the grasses of the Plains Conservation Center should have read "The Grass Flora of the Plains Conservation Center." Not all of the grasses to be found there are natives. The Center is on East Hampden Avenue.

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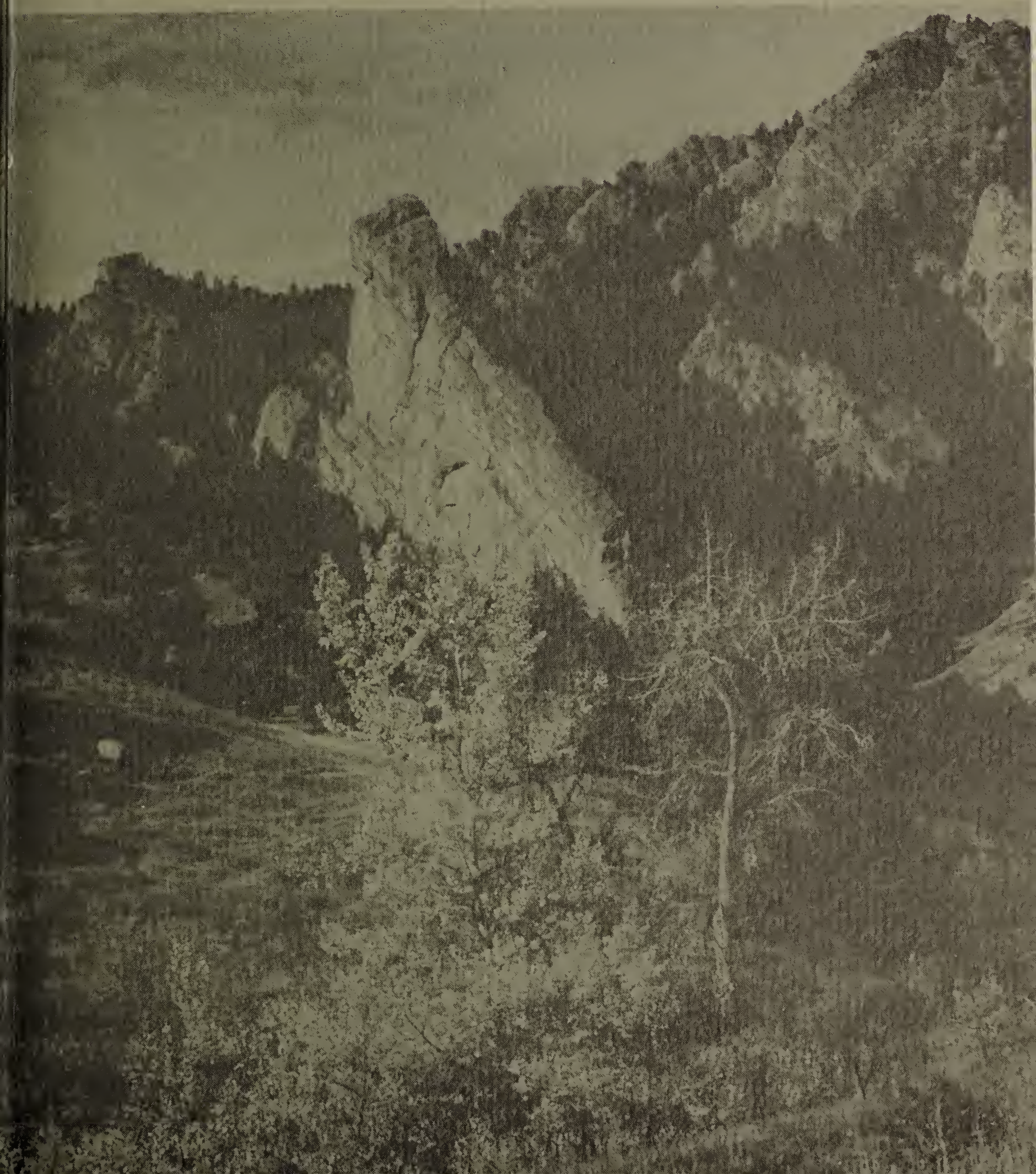
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The Green Thumb

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AUTUMN 1978



THE COVER

Autumn on the Front Range

THE GREEN THUMB

AUTUMN 1978

VOL. THIRTY-FIVE, NUMBER THREE

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William H. Anderson, Jr. Ed.D.
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Editors

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From Cemetery To Conservatory

Part VII-Congress Park and the Police and Fire Buildings

Louisa Ward Arps.

[Note: This is the last of a series of articles in *The Green Thumb* relating the history of the land around the Denver Botanic Gardens. For the history of the Gardens, see the article by Bernice E. Petersen called "Silver Jubilee Records Progress" in the 1975 *Annual Report* of the Denver Botanic Gardens.]

Larimer called it Prospect Hill in 1859 when he rode two miles east from Denver City to stake out a graveyard. Forty years later, at the turn of the century, what did the hill look like? Down the western slope a three-board fence surrounded the 80 acres we today call Cheesman Park, at that time an expanse of dry weeds pitted with holes from which bones and coffins had been extracted. East of that was the 20 acre Roman Catholic cemetery, still in use, fenced, watered, green with shrubs and trees, including cottonwoods. The 20 acres to the south awaited the decision of the U.S. Supreme Court before houses could be built on Morgan's Subdivision. East of the Catholic graveyard was a narrow strip of neglected land where paupers were buried, sometimes three deep. East of that the Jews still used their burial ground, a spot of green beauty behind its wrought iron fence. Cemetery Hill Reservoir #1, with its stone gate house, topped the hill. Nothing but weeds and yucca showed between the reservoir south to 8th Avenue (originally called Bowles Avenue).

Mrs. Louisa Ward Arps, librarian, historian, author, has spent countless hours in research for this series of articles about the history of the land surrounding the Denver Botanic Gardens. It is with regret that we come to this final chapter.

City Nursery

This emptiness changed in 1903 into the city nursery, Denver's first, with long rows of saplings along 8th Avenue, watered by the Denver Union Water Company's reservoir. Reinhard Schuetze, Denver's first landscape architect, had a theory that Denver's climate would allow many kinds of trees to grow, so he imported them from every direction except the tropics. He needed a spot to nurture them. By 1910, the trees in the city nursery were mostly elms — Mayor Speer loved elms — and maples. No box elders, because of the insidious red and black box elder bugs; no ash, because of a recent infestation of boring beetles; and certainly not one native cottonwood on account of "its being an unsightly tree alongside of the maples, elms, etc. There is a city ordinance forbidding the planting of cottonwoods."¹

A man appropriately named James Forrest, a Scot, took charge of the nursery. He and his wife had married in Aberdeen before coming to Philadelphia where he worked for a short time as a gardener. In Denver they lived for 30 years in a little white house north of the nursery, about where the swimming pool now is. Here they raised their three sons, Harry and the twins Walt and Ed. Far from being a dour Scot, Mr. Forrest was kindly, especially to the neighborhood children who played on the hill. One Denver woman remembers happy days when she and a girl friend imagined the summer trees were dark and dusky forests.

During World War I, James Forrest helped patriotic citizens raise Victory Gardens north of the nursery. They could rent 25 square feet of ground for \$5 a growing season. Mayor Speer, triumphantly back in office in 1916, used city labor to plow the land and persuaded the water company to furnish water free.

Mr. Forrest reluctantly retired about 1940, but continued to live in the little white house. He watched when the nursery was moved to Rosedale, and helped amateurs raise vegetables in their Victory Gardens of World War II. He died in 1946, but his widow stayed on in the little white house for another four years until her son Harry installed her in another small house near his home and greenhouses at West 7th Avenue and Vrain.²

Congress Park Swimming Pool, 1978



Young America League³

The transformation of the land north of 8th Avenue from nursery to Victory Gardens to today's Congress Park with its playgrounds, tennis courts, and swimming pool was gradual. The playgrounds started in 1927 at the instigation of Frederic A. Adams and his wife. Having no children of their own, they were especially interested in other people's children.⁴ When her two nephews, the Emery boys, were growing up near the park, Uncle Fred organized the Young America League, which expanded across Denver, at one time numbering 15,000 youngsters, the first such organization in the United States. The purpose of the League was not to produce professional football or baseball players, but to give energy outlet to boys from 7 to 15 years old. (The teams were classified by weight, not age.) Coached by fathers, taxied by mothers, umpired by the only paid personnel, the uniformed teams still meet three times a week after school, twice for practice and once for competition. Each team has a name, the first game being between the Pirates vs. the Rangers. Today, when the driver of a car going north on Josephine Street sees earnest little boys dwarfed inside their padded football uniforms he may be looking at Young America but he is also looking at half a century of history.

The development of the playgrounds was limited by lack of money, so the Denver Parks officials gladly utilized Work Projects Administration funds to level the sloping ground for more playgrounds. This involved building a retaining wall, running east and west, constructed with steps that are used as bleachers for spectators of important events. The playgrounds on either side of the wall are covered with lawns — no "Keep Off the Grass" signs here, or in any Denver city park.⁵

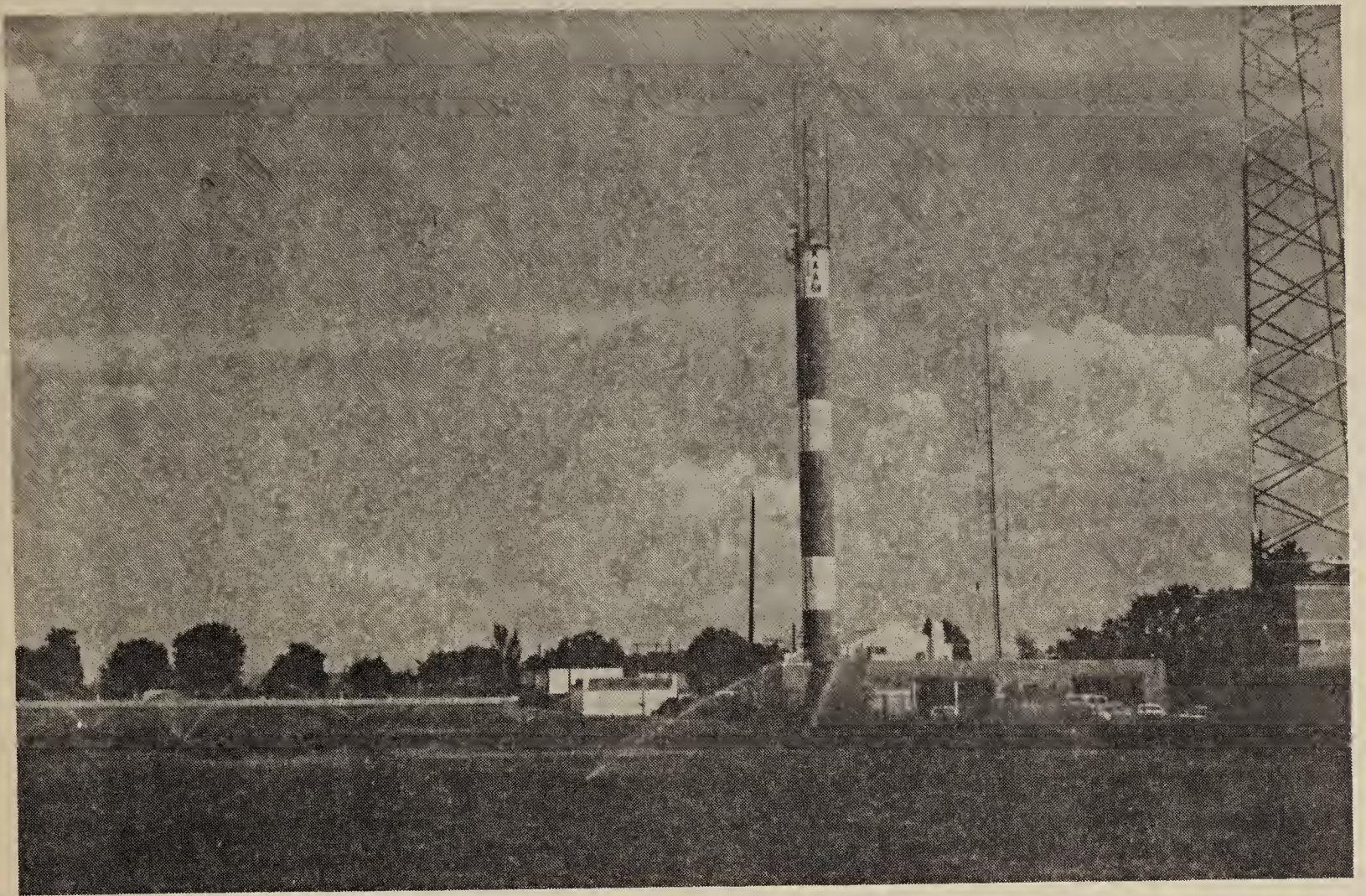
Swimming Pool

In 1947, Denver issued \$325,000 worth of bonds for parks improvements, including a swimming pool in Congress Park. Seven years of litigation followed when five neighbors of the park (four of whom lived on Detroit but represented residents of other streets) asked the courts of law to decide if a swimming pool "was a proper use for a public park." In 1955, the Colorado Supreme Court decided "yes."

Thereupon bids were asked for construction of the pool, which opened in 1955 at a cost of \$126,443. The 50 meter pool is according to Olympic standards, 60.1 feet wide, 164.2 feet long, with two diving boards, one meter and three meters above the water. The water is heated, treated, and re-circulated. The season runs from Memorial Day to September 1, always well life-guarded. (The only fatal accidents at the pool have been to people who illegally climbed the fence during off-hours.) For the small, a wading pool, swings, and slides are handy.

Four tennis courts opened in 1955 on the northeast corner of the park. Even the Water Board easement for access to the reservoirs is utilized for basketball practice. Six more tennis courts were added in 1974, carefully constructed of layers of asphalt, the top layer colored green.

This land, this Congress Park, once a dry prairie and then a nursery, now green lawns, playing fields, tennis courts, picnic spots under handsome trees, and a swimming pool, is the miracle originally wrought by Cherry Creek water running by gravity to the top of Cemetery Hill.



Police Broadcast Tower

Police Building and Broadcast Tower⁶

Three buildings in an east-west row stand between the reservoirs and Congress Park. Farthest east stands the Water Board's pump house, built in 1907, drastically changed since. In the middle is the one-story building owned by the Denver Police Department, built in 1939. On the west, 950 Josephine Street, stands the Denver Fire Alarm Building, built in 1949, before Reservoir #3 was dug north of it, and before Mount Calvary, the Roman Catholic cemetery, had turned into the Denver Botanic Gardens.

In 1939, The Denver Police Department, needing a high place from which to beam radio communications, eyed the 1916 surge pipe no longer needed but still owned by the Denver Water Department. Here was a ready-made support for their radio antenna. The policemen enjoyed telling policemen from other towns that their signals emanated from a water tower, 145 feet high and 10 feet in diameter. At its foot the department built a one-story brick building to hold the broadcasting equipment for police calls. Originally KGPX, the police call number changed to KAA 511, which is printed in large letters on top of the old water pipe, now painted in broad red and white stripes.

About 1970, the police broadcasting system was moved to even higher Mount Morrison, a foothill west of the city, but standby machinery remains in the Congress Park building, with the antenna still on top of the steel pipe. This is used when mechanical failure or the weather plagues the Mount Morrison equipment. The room housing the standby equipment is a quiet place, with one man on duty, alert to any trouble signal from Mount Morrison.

By contrast, the rest of the one-story building at the foot of the steel pipe is a beehive of activity, with policemen repairing all electronic equipment on any vehicle owned by the city of Denver — police — fire — hospital — whatever — even walkie-

talkies. No repair work on moving electronic equipment is farmed out, the supervisor proudly states.

In order to repair this sophisticated equipment, three copper-shielded rooms are needed. The last of the three rooms was built by men in the department at great savings to the taxpayer. Each room is equipped with at least \$15,000 worth of testing apparatus. In the summer of 1978 this electronic repair shop was ready to service at least 1600 pieces of equipment, and the number increases every time a city department buys another radio-equipped vehicle. Some spare sets are available, but usually repairs are made before the vehicle is called back into service. The best aid to realizing how busy this operation is consists of a peg board that holds hundreds of little round tags which identify each piece of equipment as it comes in for repair. Another sign of activity shows in the parking lot, often filled with city vehicles practically bumper to bumper.

Fire Alarm Building⁷

The first fire alarm system in Denver was one bell on a wooden tower behind 1534 Lawrence Street, the first fire station. After it was installed in 1867, when a member of the volunteer Hook and Ladder companies heard the first clash of the bell, he listened. One stroke meant the fire was in a certain part of town, two strokes in another. A louder bell was installed in 1873, but 1876 saw the fire alarm system modernized, with an electric system with 8 miles of telegraph wire on two circuits and 15 signaling devices placed around town. This system cost \$5,600, including the Gamewell signal boxes, the kind that still stood around Denver until recently, the kind that looked like little red cottages with peaked roofs, the front covered with glass. "In case of fire, break the glass and pull the key." In 1881 the fire alarm system moved to City Hall at 14th and Larimer, in which non-fireproof building it remained for 60 years until 1949, the year it moved to 950 Josephine Street, a fireproof building between the reservoirs and Congress Park.

Architects Jamieson & Stiffler designed the attractive brick structure and the Works Projects Administration financed it. The building is sturdy, with concrete walls and floors a foot thick and a four-inch double roof. The building is secure, with bullet-proof windows and steel doors, and a ten-foot high wire fence with an electronically controlled gate viewed by TV cable monitors. The equipment is efficient. The switchboard, manned by firemen, is the terminal or take-off point for all city fire alarm devices, for public school burglar alarms, and for private alarm companies. When a call comes in, the switchboard man gets the pertinent facts, such as name, address, and where the smoke or flames are rising, while the dispatcher, also listening, pulls the appropriate card from an ingenious filing system that divides the city into 140 sectors, and notifies the nearest fire station by telephone, radio, or vocalarm. (Vocalarm, the brainchild of Denver firemen, sends orders and information by micro-wave or hard-wire. The system has been copied by fire departments in the United States and other countries.)

Civil Defense Sirens

On the roof of the Fire Alarm Building are the civil defense sirens, originally used for air raid warnings in World War II, now ready for any emergency. Here are the master alarms, with at least 50 subsidiary sirens in Denver, and many in Aurora and



The Pump House in 1978

other outlying towns. Although the sirens are on the roof of the Fire Alarm Building, they are set off only under the direction of the Office of Emergency Preparedness.

Broadcasting Tower

The Fire Department picked the site at 950 Josephine Street because (1), although it is practically in the inner city, open space surrounds it; and (2) the spot, 5390 feet above sea level, is one of the highest in the "Mile-High City" of Denver. The transmission tower rises 225 feet above the already high ground, as high as the Stapleton Air Field authorities would allow. It stands alone, with no guy wires to brace its steel girders. Because of its height, micro-wave signals carry in a straight line to most of the fire stations in Denver except those downtown where, because of interference from high buildings, the signals are carried by hard-wire.

KHW — 35 — ITV⁸

A history of broadcasting from Congress Park must not ignore another milestone in public broadcasting originating with the Denver Fire Department. For five years, from 1969 to 1974, the basement of the Fire Alarm Building housed a television studio. The idea started back in 1964 when Manager of Safety Daniel S. Hoffman noted that to familiarize fire department personnel with a new piece of equipment took at least two visits to each of 34 stations, more if the men were called to put out a fire. Television would solve the problem by broadcasting educational material, instructions, and announcements to various fire stations, police stations, and other public closed-circuit channels all over the city. After almost two years of persuasion, the FCC finally granted Denver's wish. The Denver Fire Department at 950 Josephine Street acquired a broadcasting license and frequency allocation (2584-2590 MHz). The call letters are KHW — 35 — ITV (meaning instructional television). The original Channel 4 has been changed to Channel 12.

The Fire Department was glad to have permission, but it had no money. Somehow the money was raised, some from the government, some from individual people, some from companies like Mountain States Telephone Company, some from foundations like Boettcher and Coors. The firemen alone raised \$200,000, including

the money obtained by collecting and re-cycling aluminum cans. In the fall of 1969, America's first public safety television beamed its first picture from the police tower.

Rapid expansion required that the studio move on September 1, 1974, to a color-equipped broadcasting studio at the Denver Police Academy, 550 East Iliff Avenue, but the pictures still are beamed from the tower at Congress Park.

If the trees west of Congress Park could be removed (which God forbid!) and the apartment houses eradicated, from downtown Denver what historic remnants could be seen sticking up above the skyline of Congress Park? No gravestones, no pest house, no smoke stack, but reservoirs, the oldest 90 years old; a pump house 71 years old; a 145-foot steel pipe 62 years old; middle-aged police and fire buildings; and a teen-aged transmission tower, on its very top a red safety light incessantly blinking above what was once known as Prospect Hill.

NOTES

1. *Denver Municipal Facts*, Sept. 10, 1910, p. 4. In 1978, an ordinance still forbids planting cottonwoods between the street and the sidewalk.
2. Conversation with Mrs. Harry W. Forrest, Oct. 7, 1977.
3. Conversation with Michael O'Donahue, Chairman of the Board of Young America League, 1978.
4. Mrs. Frederic A. Adams (nee Minnie Washburn) was the prime mover for the Santa Claus Shop which provides Christmas presents for Denver children who would otherwise be without gifts.
5. Rod Wiberg of the Denver Parks Department furnished most of the material on Congress Park, supplemented by other officials, active or retired, especially David Abbott, James Bible, and Betty Peters.
6. Conversation with George Danhauer, supervisor of the Police Building in Congress Park.
7. Conversation with Patrick H. Mahoney, Superintendent of the Fire Alarm Building. The Denver Fire Department published a pamphlet, compiled by Mike Smith, undated but probably in 1975, which gives in detail the operation of the fire alarm headquarters.
8. Conversation with Laurence C. Way, retired Superintendent of the Fire Alarm Division of the Denver Fire Department, and with officers of KHW-35 at the Denver Police Academy, Frank Smith told of the experiment of putting television equipment in a city helicopter which was so heavy the helicopter could not rise from the ground. An undated pamphlet by Richard W. Dunshee, published by the University of Denver, tells of the beginning of KHW-35.



The 1907 Pump House

Ruth Ashton Nelson

The Early Years

Marjorie L. Shepherd

Ruth Ashton's parents were brought up in the middle west, but they migrated to Boston as they were interested in some sort of work for humanity. It was the time when the settlement houses were the thing that one did to help people in the slums. They started a little house in Roxbury, part of Boston, and both Ruth and her sister were born there. Ruth's mother was not very strong physically and her health gave out, so they went to a farm on Martha's Vineyard with the idea that they would eventually take children from the city in place of the settlement work. Later they gave up that idea and the farm became their home. It was on the north shore of the island about four miles from Woods Hole.

In 1905, having spent some time during the previous winter at Mr. Ashton's old home in Rockford, they had become interested in the Rocky Mountains and Estes Park in particular, probably through friends they had met during the winter. That summer they went to Estes Park, by train to Denver, on to Lyons, and then by stage to the Park. By the time they arrived it was chilly and they were glad to be settled in the cottage on the Big Thompson River in what was known as the Denver-Boulder Colony.

They rented a burro from Enos Mills and a burro and pony from Van's Service and learned to take care of them and ride them. This was their introduction to horseback riding. There was a three year old brother who was fascinated by the rushing water of the river and kept his mother busy as she did not dare let him out of her sight.

The wild flowers near the cabin interested them and on the occasion of the mother's fortieth birthday, the children were able to collect forty different kinds of flowers. There were probably more but they thought that was pretty good.

During the summer, they explored the area. One trip was to Bear Lake and since this was only a few years after the big fire, the slopes of the mountains around the lake looked quite desolate. Another trip was to Bierstadt Lake where they saw the beautiful view of Long's Peak across the lake — the original of the Bierstadt painting that has become so famous.

Late in the summer an overnight trip was made to Lawn Lake where they stayed in an old cabin which had probably been built for workers at the dam because even then the level of the lake had been raised to store irrigation water. The cabin was small and dark.

Mrs. Shepherd's relationship with the Denver Botanic Gardens began in the days of the Colorado Forestry and Horticulture Association when she and Dr. Brunquist were instrumental in the formation of the Botany Club and when she worked with many others toward a Denver Botanic Gardens. She is a volunteer in the Kathryn Kalmbach Herbarium. She has known Ruth Nelson well for more than 25 years.

The next day they climbed to the ridge above Crystal Lake where they could look over into the Poudre Valley. Ruth says, 'We lay on the ground there at that sharp precipice, looked down and were very much thrilled with all the alpine flowers — that was an inspiring experience for all of us.'

Although they did not have much in the way of supplies, Ruth's mother was so enthusiastic that they stayed another night. Instead of using the cabin, it was decided to sleep outside. It was cold and there was ice in the edge of the little stream in the morning. It was a wonderful experience to be there under the stars which were huge and brilliant and close. Part way down the next day, they stopped at Horseshoe Ranch and persuaded the owner to give them a meal as they were all out of food. This was Ruth's first experience of camping in the Rockies.

In the spring of 1906, the family returned to the farm on Martha's Vineyard which became their home from that time on, but they always wanted to get back to the Rockies. The family spent long summers on the farm from April to November. Ruth says she usually had a few house plants to take to the farm. She can remember standing in the middle of the big South Station in Boston waiting with the family for the train with a grape basket in her hand with four or five little pots of plants that she had to carry with her when they traveled.

In about 1912, they returned to the Rockies, this time going to Bailey where they stayed at Glenn Isle for a time and then were permitted to set up a camp near the hotel. It turned out to be a rainy summer and the children were sure that it didn't rain like that at Estes Park. The summer they had stayed there, it would cloud up around noon, there would be a little shower and then be bright and clear again. There was a guide at Glenn Isle who rented burros and horses. Ruth's mother arranged for him to take them on a pack trip and finally arrive at Estes Park. They started up the Platte in the direction of South Park. Ruth says, "I know we crossed the northern edge of South Park because I remember distinctly great fields of blue gentian and I was thrilled with those great sheets of blue."

Arriving at Dillon, then a little mining town, their arrival (a woman with three children and a guide) stirred quite a bit of excitement in the little village and while they were buying supplies in the store many of the residents turned up with some sort of errand.

Following the Blue, they arrived at Hot Sulphur Springs eleven days after leaving Bailey. Here the trip ended and they camped out at the edge of town and took some of their meals at the hotel which is still standing. The children went to the little two-room schoolhouse for about 2 months. The weather began to get cooler and they would put their slickers over the bed rolls. There would be frost on the slickers in the morning. When they started home, they went to Denver on the Moffat Road in the days when it went right over the top of Corona Pass.

Later on they did spend another summer at Estes Park, staying at several different resorts including McPherson Lodge which has since been made into the National Park Museum.

After that Ruth always wanted to get back to the Rocky Mountains and particularly to Estes Park. So, after she had graduated from college, Mt. Holyoke, she did return to the park to be a counselor at a girl's camp located near Twin Sisters. She taught horseback riding, taking the little girls on trips around the area. She also taught them about flowers, birds, and animals as well as she could.

When the summer was over, Ruth decided to stay in Estes Park and rented a small cottage belonging to the Clatworthys right close to the Big Thompson River. It was very cold there in the winter.

There was still some land available for homesteading and she spent the winter hiking to the various locations. She found that all of them were high up on rocky, dry slopes with no water and were not suitable for homesteading. In the spring she found some land for sale, northeast of the village at what seemed to be a very reasonable price. It consisted of two separate homesteads and comprised 240 acres. Her father was willing to help her buy the property and so Ruth became owner of what she calls "Skyland Ranch" in March 1925. It is a beautiful location with a splendid view of Long's Peak.

Ruth had been asked to spend another summer at the girl's camp but she found that there was an opening in the Park Service for an information clerk. She was able to get the position and spent that summer and the following two summers in the Park Service.

In 1928 Ruth applied to attend the training school for naturalists which was held at Yosemite National Park as she hoped to get into the naturalist service in the park. The men who were in charge of the instruction were the great naturalists of the early days of the Park Service, particularly Harold Bryant, Carl Russell, and Joe Dixon. The summer was a wonderful experience.

In the meantime Ruth had been working on her Master's degree in Botany at the State University in Fort Collins and she went on with this during the winter. Mr. Toll who had been superintendent of the park was transferred to Yellowstone and he was replaced by Edmund Rogers. When Ruth re-applied for her former job, she was accepted and spent three more summers as information clerk.

In the spring of 1930, Ruth was granted her Master's degree. Her thesis was on the plants of Rocky Mountain National Park. She had applied to Dr. Aven Nelson for help in identifying species which had given her trouble. He had taken an interest and very graciously helped her. She had become a member of the Colorado-Wyoming Academy of Science and presented a paper at one of the meetings on the "Ferns of Rocky Mountain National Park." In this way, she had become acquainted with Dr. Nelson. He hired her as a graduate assistant for herbarium work at the University of Wyoming for the year 1930-1931 so she went to Laramie at the end of the park season. This was the Rocky Mountain Herbarium which was recognized as the leading herbarium for Rocky Mountain Plants at that time and had been developed by Dr. Nelson.

There was no complete list of plants in the park at the time she started working at the park, and Ruth had worked on this in connection with her thesis. The Park Service people were interested in having this developed into a publication for the park. This was completed in the spring of 1931 and was published by the government printing office and sold for 25¢ a copy.

The summer of 1931 was spent back at the park, her last in the Park Service. By then Dr. Nelson and Ruth had decided to be married. His first wife had passed away three years previously. They went down to Santa Fe and were married. After a trip through New Mexico and Texas, they arrived at New Orleans and attended the meeting of the American Association for the Advancement of Science. At this meeting, Dr. Nelson was elected President of the Botanical Society of America. He was also President General of Phi Kappa Phi.

After a leisurely trip home, they arrived in Laramie and Dr. Nelson picked up his work at the University. He was still teaching some graduate work and was curator of the herbarium. Ruth continued her work in the herbarium as his unofficial assistant.



A Budding Botanist, Age 7

Dr. Nelson had been in the habit of attending the International Botanical Congress and in 1935 it was to be held in Amsterdam in September. The Nelsons planned a trip for the Botanical Society to precede the congress and the group toured Europe visiting botanical gardens and other places of interest. Following the congress they took a trip to Norway. His parents had come from the area near Stavanger and they visited the old family farm. They also were in Sweden and Denmark briefly before returning home to Laramie.

In 1939 the Nelsons were able to make arrangements with the National Park Service to spend the summer in Alaska working on the flora of Mt. McKinley National Park. They became collaborators with the government and were given transportation from Seattle and accommodations in the park for the summer. They arrived at the park about the 23rd of June. It was 1 a.m., it was twilight and misty but it was light. The Park Service settled them in a little log cabin at headquarters where they were to stay for the summer except for a few places away from their cabin where there was another cabin or a tent set up for them.

There was a road from headquarters to the northeast boundary of the park 100 miles in length. It was the only road and there were no passenger cars. Collecting and exploring were accomplished by leaving the cabin in the morning with park personnel on their way out to a work area in whatever vehicle was being used. They were picked up by the work crew on the return trip.

A tent house was set up for them at Wonder Lake for a week. The weather was perfect and the mountains were visible day after day. Another time they spent several days in a patrol cabin at Toklat where there was an opportunity to see the wildlife. They saw wolves, a caribou migration, foxes, and even wolverines. It was a wonderful summer with much good weather and opportunities to really live with the country there.

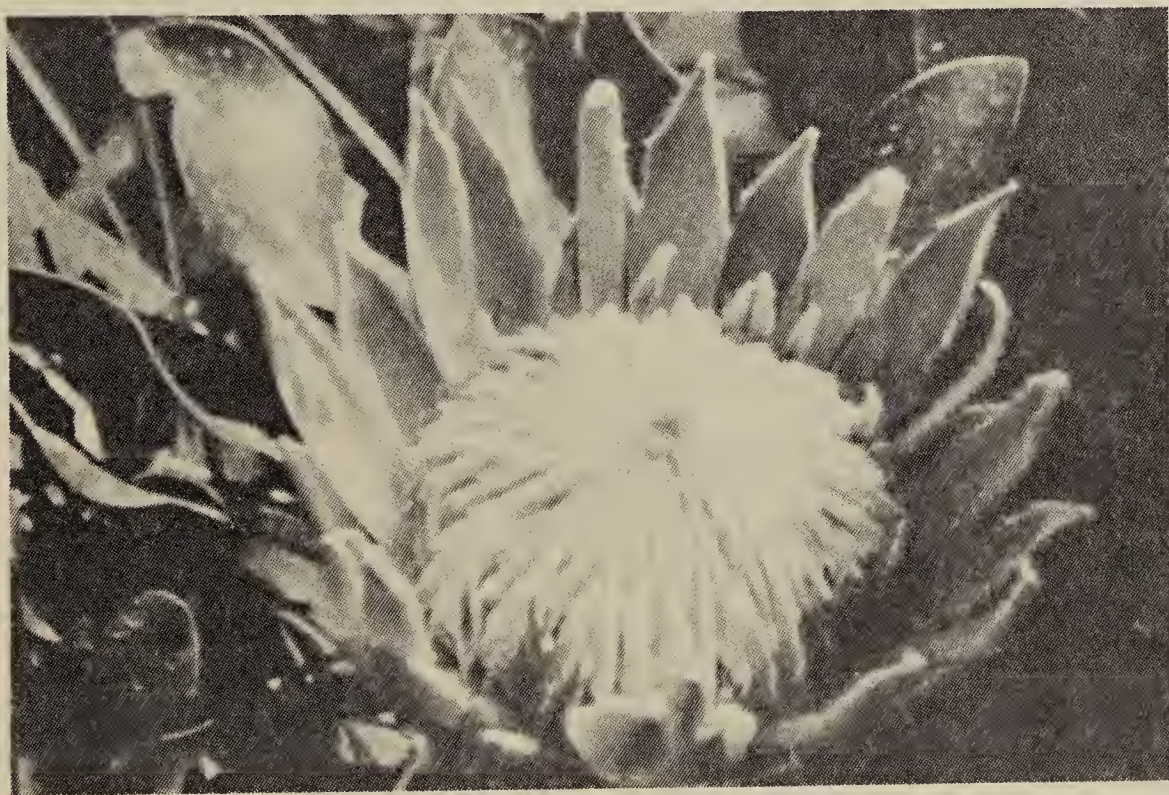
They made a report on their work to the Park Service, a complete list of plants with a good many black and white photographs. (Color equipment had been taken but an accident had made the camera inoperable.) The return trip from Seward to Seattle was on a little Wildlife Division boat called the "Brown Bear." She was very small and the trip was very, very rough.

A trip was made through the Canadian Rockies and clear across Canada to Montreal and Ottawa, always collecting plants. It must have been in this period that they joined the Colorado Mountain Club on an outing to Lindbergh Peak. I was not there but have often heard mention of it and how much the Nelsons were enjoyed.

In the spring of 1944 they went to Norman, Oklahoma. Dr. Nelson had very severe asthma and the Wyoming winters were very hard on him. He wanted to find a place in a milder climate. He eventually landed a job for Ruth as herbarium assistant at the University and he had an office where he could write and do research. In the fall, because of the war they were short of instructors so Ruth was pressed into service and she taught the elementary botany courses for a semester, returning to the herbarium afterward. They took many interesting trips while at Norman exploring the fringes of the Ozark Mountains. The flora there was wonderful, being a combination of Atlantic Coastal Plainland and Ozarkian flora with many species Ruth had known in New England as a child, and some species that had come in from the South. They had very happy and profitable experiences there.

Dr. Nelson was in ill health and a move was made to Colorado Springs where he could have the care he needed. There he passed away. This was the end of a happy companionship and a time for new beginnings.

(The foregoing is from a tape made on June 1, 1978 at Estes Park.)



PROTEA CYNARIOIDES L.

This large and attractive specimen of Protaceae bloomed in one of the Denver Botanic Gardens' greenhouses late in the spring of 1978. It is quite probably the first of its species to have bloomed in Denver. The seed from which it grew was obtained from Darwin, New Zealand in early 1975. The large bloom, often called King Protea, was five inches across. The family Protaceae has 50 genera and more than 1100 species.

Gardens in Southern Europe

The 1978 Botanic Gardens Overseas Trip

Francis H. Elmore

A 17-day botanical exploration of gardens and wildflowers of southern Europe formed the objective of the Denver Botanic Gardens' 1978 Tour which took flight out of Denver on Sunday, April 23. The itinerary took us into Portugal, the garden island of Madeira, the Netherlands (though inadvertently), Italy, and Greece. As with all of the Gardens' tours, we were accompanied by Director Dr. William G. Gambill, Jr., and personally escorted by travel agents Jim and Alice Holme and local professional guides.

Upon touchdown in Portugal, we stepped into a subtropical paradise starting with Lisbon, the charming capital city, with its abundance of flowers in parks, gardens, and along streets lined with palms, pines, carobs, eucalypti, plane trees, complemented by calla lilies, geraniums, azaleas — one can but begin

Francis H. Elmore is a graduate of the University of Southern California with an A.B. degree in botany and a M.S. degree in archeology and anthropology. Before his retirement, he worked for the National Park Service for 30 years. He was chief park naturalist at Glacier National Park for 12 years. In 1976 his *Shrubs and Trees of the Southwest Uplands* was published by the Southwest Parks and Monuments Association. His retirement so far has been devoted to travel, writing, and research.

to list the flora observed. Red-tiled roofs and vari-hued houses with wrought iron grills in the Moorish tradition added to the color.

Excursions Begin

Our introduction to the "Land of Cork" began with a full-day exploration of the region northeast of Lisbon. Numerous stops were made to photograph and botanize. At Sintra, which sits amid luxurious vegetation in the hills of the same name, we visited the favorite residence of Portuguese monarchs, now the Hotel Palacio de Seteais in a gorgeous setting of well-kept lawns and hedges, fountains and azaleas. Seteais is said to derive its name from a sevenfold echo. We saw a Moorish castle on a hilltop, the Royal Palace with its conical kitchen chimneys, and were guests in the outstanding home of James Mackenzie — Quinta da Alegria (Joyful Country House). Lord Byron described Sintra as a "glorious Eden," and many great writers and poets were inspired by it.

We then headed into the countryside through orange and olive groves, vineyards, forests of pine and eucalyptus, and stands of cork oak. The bark (cork) of cork oak takes 15 to 20 years to

mature, is then stripped, and subsequently restripped every 8 to 10 years from trees which live over 150 years. Then came Mafra with marble quarries and a most impressive monastery, and still another palace rivaling the Spanish Escorial. Bussing through the terrain, we passed windmills, umbrella pines, and more cork oaks, arriving at Cascais, a picturesque fishing village and international seaside resort on the Atlantic Ocean. This was the start of Portugal's "Sunny Coast," which includes Estoril and its lovely gardens, including palms, bougainvilleas, and more azaleas.

to the Estufa Fria (Cold Greenhouse) and Estufa Quente (Hothouse). These house one of the world's best collections of plants, trees, and shrubs brought back by early Portuguese explorers from the four corners of the earth. Among the many plants noted in the houses, interspersed with ponds and grottos, were asparagus "ferns," elegant palms, hibiscus, camellias, bananas, tree ferns, lotus, water lilies, orchids, bromeliads, bamboos, cacti, magnolias, garden balsam, spider lilies, and *Brunfelsia*.



Group in Funchal City Park

The next day was spent on another swing through rural environs to Queluz where we visited the pink rococco "Palacio Nacional" inspired by Versailles — its furnishings making it a veritable museum. The formal gardens were designed in 1762 and were of clipped box, cypress, masses of flowers and shrubs, statuary, lakes and fountains, and included an Italian-style garden.

After a sumptuous lunch in the converted kitchen of the Palace we returned to Lisbon. A highlight there was a visit

Lisbon Sight Seeing

A visit to the Gulbenkian Art Museum rewarded the visitor with works ranging from the dawn of Egyptian history through 20th-century French. The building itself is surrounded by two beautiful gardens — one European, the other Oriental.

Also seen in and around Lisbon were Prince Henry the Navigator's Monument to Discoveries; Jerónimos Monastery, started in 1502 under King Manuel in

thanksgiving for discoveries made by Portuguese navigators; the Tower of Belém, and the Marquesa de Fronteira's formal and informal gardens in Benfica. Horse chestnut, redbud, magnolia, cypress *araucaria* (both the monkey puzzle and Norfolk Island pine) were observed as well as dozens of varieties of flowering plants.

Madeira Delightful

The second chapter of our journey began by flying 535 miles southwest from Lisbon to the Pearl of the Atlantic — semitropical Madeira discovered by the Portuguese in 1419. It is especially noted for its wine, embroidery, and wickerware. Delightful were the green-clad hills, rocky cliffs, and forested mountains. In this setting grows a profusion of wild and cultivated trees and flowers, many introduced by the early Portuguese, some becoming naturalized. Among the 2400 species, there are about 100 that are truly Madeiran, including three endemic ferns and a geranium. Lily-of-the-valley tree (*Clethra arborea* Ait.) and a tree laurel (*Persea*) are genera also found here which are otherwise American. (*P. americana* Mill. is the avocado.)

The capital city of Funchal (fennel) is a most attractive resort town situated on a magnificent bay. Its main street is lined with *jacaranda*; many sidewalks are cobblestoned mosaics of black basalt and white limestone. Of interest were the cathedral Sé, the vegetable and flower markets, and the city's numerous parks and gardens. A small well-kept botanic garden is located in the foothills on the grounds of an old country villa and contains examples of many types of Madeiran and exotic flora. Of special note were the magueys (American), dragon tree, Nile lily, bougainvillea, coral trees, acacias, and *Echium candicans* L.s., known as the pride of Madeira. Another larger garden was

visited high in the mountains and contained many trees including a grove of sequoias and *Juniperus oxycedrus* L.

An all-day trip across the island on winding roads through pines, eucalypti, acacias, and Douglas-firs gave an overall view of the mountainous terrain. Many terraced and cultivated farms and farmhouses including thatch-roofed sheds where cows bedded down dotted the landscape. There was not a single cow in evidence (though butter is a major dairy product) and for good reason — lack of grazing space (too steep) forces the farmers to keep their cows confined. Because of this, the cows are hand fed (breakfast in bed?) and leashed and walked for exercise.

Wickerwork Important

Vine-covered cottages and red-tiled roofs were everywhere and moulded figurines (heads, birds, animals) graced the four roof corners on some. Many willow plantations of stumpy trees in varying stages of growth were seen, and a stop was made at Camacha, the center of the wickerwork industry. The stumps grow withes or osiers which are cut, peeled and gathered in bundles for drying and storing. Along the roadsides, beside cottages, and on rooftops were these bundles stacked for drying. When completely dry, they are boiled in water to make them more flexible for working. The finished products — over 800 different kinds of baskets, in addition to stools, tables, chairs, and even animals — are to be seen throughout the island. Wickerwork is truly a cottage industry in Madeira.

The land burgeons on all sides with plumeria, hibiscus, poinsettia, hydrangea, silk-oak, kapok, camellias, Scotch broom, geraniums, orchids, orchid trees, and African tulip trees. Among the introduced fruits were bananas, sugar cane, grapes (the three principal crops),

avocado, papaya, passion fruit, figs, custard apples, mangoes, oranges, lemons, and tangerines. Numerous *levadas* were encountered — a unique and complex irrigation system bringing water from the mountains to fields and villages below. Eventually the north side of the island was reached at Porto da Cruz with its towering Eagle Rock, bringing us to sea level. Then a climb back up into the mountains to Ribeiro

Holland Inadvertently

The old bromide, "If this is Sunday, it must be Rome," turned out to be false, as we awoke in Eindhoven, Netherlands due to a rescheduling of our flight to canal-ringed Amsterdam on Lake Ijssel (formerly the Zuider Zee). Canals, dikes and ponds, but few windmills were in evidence. The countryside



Marquesa de Fronteira's Garden

Frio and its government trout hatchery and collection of island plants, the Douglas-fir again, planted by the government in its reforestation efforts. From Poiso Pass (4630') were magnificent panoramas, not the least of which was Arieiro Peak (nearly 5500'). Madeira can truly be called the Garden Island.

was green and serene. Flowers were seen, especially tulips, narcissuses, and crocuses, with a few trees breaking the skyline. The flight from 12 feet below sea level to Rome via THAI Airways included orchid corsages.

Rome — The Eternal City — one of the richest in the world in history and

art is of great cultural, religious, and intellectual interest. Reminders of the city's past are everywhere. One is never quite prepared for it.

Vatican Gardens Visited

Our introduction to the 2000-year-old capital was in the Vatican Gardens, several acres on Vatican Hill overlooking St. Peter's Basilica. At the entrance we were greeted by a Swiss Guard in his colorful red, yellow, and blue uniform designed by Michelangelo. Besides the "natural" landscaping, there were several types of gardens: English, Italian, French, cacti and succulent, perennial and annual. Throughout the gardens were many buildings which included the Vatican railway station with its lion fountain; the Palace of Governorship, in front of which were flower beds forming the Papal coat of arms; a grotto of Lourdes; Radio Vatican; the Ethiopian College; and the Walls of Leo IV. The Pope's private garden contained beans, bananas, rosemary, lemon and orange trees, and more. Hundreds of varieties of herbs, shrubs, and trees from the world over were observed. Noteworthy were American species such as western red cedar, Arizona cypress, eastern white pine, and magnolias among Italian cypress, at least four other pines, Atlas, deodar, and Lebanon cedars, holly oak and palms; cherry, olive, orange, lemon, and plum trees; viburnum, azalea, yew, cotoneaster, aralia, roses, and wisteria; mesembryanthemum, sedum, cacti, lily-of-the-valley, calla lilies, and geraniums, to mention only a few.

In Rome itself, a city tour took us to all of the storied points of interest, both ancient and modern: the Spanish Steps, the Trevi Fountain, several forums, the House of the Vestal Virgins, the Arch of Constantine, the Colosseum. It was interesting to find that a botanical study had been made of the plants that grow

in the Colosseum. The Municipal Rose Gardens with their hundreds of varieties of roses, from miniatures a few inches high to 8 to 10 foot rugosas, have plots where plants in international competition for new varieties are grown, and international winners from past years are shown. St. Peter's was overwhelming — said to be the largest church in the world it sits atop the site where tradition places St. Peter's tomb. We were awed by the many examples there of the world's most famous art.

Other Excursions

Castel Gondolfo, Tivoli, Pompeii, Naples, and Sorrento were all included in our itinerary. Everywhere we saw splendid architecture, glorious gardens, sculptures, and the famous antiquities that all the world knows.

Next we flew to Athens, where our super guide Leda made history come alive with a tour of the Acropolis, which dominates the Athens skyline with a particularly beautiful view of the tree-lined streets and many green parks. Reminders of antiquity highlighted an Athens tour where we saw the Agora, Arch of Hadrian, the Temple of Zeus, Monument to Philopappus, and the Tower of the Winds. A quick walk through the National Archeological Museum revealed a whole span of artifacts from primitive to classical Greek.

Kifissia Visited

A side trip was made to the garden suburb of Kifissia to see the flower fair and to visit the Goulandris Natural History Museum. The show was located in the city park where each exhibitor had a booth filled with flowers: orchids, bougainvilleas, hydrangeas (some as large as cabbages), mesembryanthemums, and others among a setting of palm and plane trees. The museum contained exhibits of plants, seashells, butterflies,

minerals, and birds. Most interesting were the models of orchids (*Ophrys*) whose modified lower lips remarkably resemble bees, flies, or spiders.

Finally, a three-day journey took us to the Peloponnesian Peninsula via the Isthmus of Corinth. Beyond were modern and ancient Corinth from which currants derive their name, *rayson of Coraunte*, a sharp-flavored raisin. Currants are still their chief export, together with olive oil, cereals, and silk. As we progressed through the countryside, vineyards, lemon and orange groves, loquat orchards, kumquat plantings, olive trees, watermelon patches, artichoke gardens, and bean and potato plots were seen. Agaves, roses, rock-roses (*Cistus*), poppies, palms, elderberries, and cypresses flourished in the flowering countryside. Very few fences appeared, because, we were told, Greek farmers are utterly honest. Small shrines at the edges of many fields contained icons, flowers, lamps, and bottles of oil.

Next morning found us on our way to Olympia through extensive fruit orchards, paralleling the Ionian Sea. Olympia is situated in peaceful, pineclad Alpheus Valley at the foot of Cronion Hill.

A 20-minute ferry ride across the Gulf of Corinth put us back on mainland Greece on our way to legendary Delphi, abode of the sun-god Apollo and home of the mysterious oracle which "spoke" in verse and prose. It is a most impressive site situated among olive, almond, pine, and cypress trees. Looming over this religious center of classical Greece is a spur of Mt. Parnassus, from which grass-of-Parnassus of the saxifrage family derives its name. It was interesting to note that the oracle (Pythia) not only chewed the leaves of the sacred laurel, but also burned them together with barley as part of the oracular ceremonies. The return trip was made through Arachova, noted for its embroideries and weavings, Lavadia, and Thebes, founded by Cadmus, one of whose daughters was Agave.

Our return flight reached its first landfall over still-icy Newfoundland, landed in New York for a change of planes, and arrived in Denver late evening of May 9. Surely, we all were left with fond memories of multitudinous flowering plants, of tasting various regional dishes, of trying to master foreign currencies, and of sampling fresh fruits and local wines. All in all it was a fascinating tour which will be long remembered.



Camellia in Mackenzie Garden

A Tribute to Lucy Crissey

In 1964 when Miss Lucy Crissey came to the Denver Botanic Gardens House to volunteer her services in the Helen Fowler Library, there were few aware that her capability would so greatly benefit and give impetus to the use of the library. Her modest and unpretentious manner did not disclose her scholarly background and achievements in library service.

Lucy Crissey was a native of New York State, and after being graduated from Mt. Holyoke College in So. Hadley, Mass. with her B.A. degree, she moved to New York City. There she selected librarianship as her career and enrolled at the Columbia University School of Library Service. While working on her graduate degree she was employed at the New York Public Library, and later became the Assistant Director of library training classes there. After receiving her degree in librarianship, she was appointed on the staff of the Columbia University School of Library Service and became the Associate Dean of the Department of Library Service. She held this position until she retired in 1963.

By nature Lucy was not a "joiner" but had an interest in educational organizations and was an active member

Mrs. Wilson is a professional librarian who was one of the earliest volunteers in the Denver Botanic Gardens Helen Fowler Library where she was associated with Miss Crissey for many years. She was a long time member of the Library Committee.

of the American Library Association. Her many years of participation in the field of librarianship made her a valuable member of the Editorial Committee of the first edition of *Who's Who in Library Service*. Among her special honors was the 1957 annual award for "Distinguished Service To Education For Librarianship" from the Beta Phi Mu International Library Science Honor Fraternity of which she was a member. Lucy Crissey was also the recipient of the Edna M. Saunderson Memorial Award from the Alumni Association of Columbia University School of Library Service.

Upon her retirement she fulfilled her wish to leave the hubbub of New York City and move to Denver where she had spent happy vacations with many friends. Through her librarian associates she learned that the Helen Fowler Library (then located in the Denver Botanic Gardens House) was in dire need of volunteer assistants. Due to a limited budget there had never been an official staff librarian, consequently the functioning of the library was entirely in the hands of volunteers. At this time the little library was attracting retired, trained librarians as the word of need was spread and Miss Crissey was among the first of them to volunteer. Lucy accepted every challenge, from sorting years of accumulated periodicals stored in the dusty, dim basement, to cataloging the newest acquisitions. She gave impetus to the scheduling of volunteers in order that the library could be open

regular hours on a weekly basis. When other volunteers were not available on Saturday or Sunday, Miss Crissey was there. She was selected head of the Helen Fowler Library Committee.



Miss Lucy Crissey

With the opening of the Boettcher Memorial Conservatory came increased demand for books on tropical and exotic plants. This required intensified study of botanical terminology and classification in order to catalog the scientific works and answer reference questions intelligently. Aside from the library tasks, Lucy's friendliness re-kindled the interest and enthusiasm of the Denver Botanic Gardens members and benefactors toward the Helen Fowler Library.

When the Boettcher Memorial Education Building was in the planning stage, Miss Crissey's suggestions for space and structural requirements of an expanding library were gratefully received. At last in the new building, the library came under the direction of a professional salaried staff librarian. Although the number of library volunteers increased rapidly with the library's "rebirth," Miss Crissey continued with her support. There had long been a need for a cumulative index to *The Green Thumb* publications. Lucy added many more hours of service to her record by her cooperation in the production of a card catalog index to the first twenty-five years of the publication. In recognition of her years of volunteer service the Denver Botanic Gardens Board of Trustees in 1973 designated her as Honorary Librarian.

As her health began to fail Lucy Crissey reluctantly relinquished her part in library activities. She died March 25th, 1978 leaving many saddened friends. Her legacy to The Denver Botanic Gardens, The Helen Fowler Library, and the Volunteer Associates cannot be measured in dollars nor hours. She will always be remembered with respectful gratitude for her valued contribution toward the progress and development of the library.

Edith Wilson

Exotics of COLORADO

European Mountain Ash

Sorbus aucuparia

Helen Marsh Zeiner

Sorbus aucuparia L., the European mountain ash, is one of the most beautiful trees for fall color to be seen in the Denver area. Its leaves turn a brilliant orange-red and it bears bright orange-red fruits which remain on the tree all winter if not taken by birds.

Mountain ash trees are small and suitable for city use. They are valued for their foliage which is attractive in summer as well as in autumn, their clusters of white flowers in spring, and their red fruits. They are recommended trees for this area. When young the trunk should be protected against sunscald, but once established mountain ash grows well and is a beautiful small shade tree.

Dr. Zeiner holds a Ph.D. in botany and taught in the botany department at the University of Denver. She is the honorary curator of the Denver Botanic Gardens herbarium and is a regular contributor to *The Green Thumb*.

Sorbus aucuparia is a member of the rose family, Rosaceae. Its leaves are pinnately compound and resemble those of roses. The small white flowers, each like a miniature single rose, are borne in flat clusters. The fruits are berrylike pomes which resemble miniature apples. Although the fruits are edible, they have a very unpleasant taste. Birds eat them, however, although sometimes as a second choice. Often in late winter or early spring when little food is available for birds, a flock of birds will come to a mountain ash tree and take all the fruits left hanging on it. Some varieties grown in Europe have pleasantly flavored fruits used in making jelly.

The American mountain ash, *Sorbus americana* Marsh., is also recommended for Denver. It is very similar to European mountain ash, but can be distinguished by the shape of the leaflets and by the winter buds. *Sorbus aucuparia* has leaflets which are blunt or very short pointed and which are

pubescent beneath, although they sometimes lose their pubescence at maturity. Leaflets of *Sorbus americana* are acuminate and taper-pointed and glabrous beneath. The winter buds of European mountain ash are pubescent; those of American mountain ash are glabrous or very slightly pubescent. Of the two trees, European mountain ash is more commonly grown.

Sorbus is the ancient Latin name for the mountain ash. *Aucuparia* refers to the use of the fruit in catching birds and is from the Latin *aucupatio* meaning fowling or bird catching. *Americana* means American.

European mountain ash is often called rowan tree in Europe and England. It has been a very useful as well as ornamental tree. All parts are astringent and have been used in tanning leather. Various parts of the tree have also been used as a black dye. The wood is used for poles and as hoops for barrels. In herbal medicine the bark was used as a tonic in fevers, and an astringent gargle for sore throats was made from ripe berries.

Some interesting superstitions have grown up around this tree. It is said that wood from a rowan tree saved Thor from drowning in a flood, and that ship builders put at least one plank of this wood into the hull of every ship to protect from drowning. It is believed that Thor's plank will save a Norwegian ship but will sink one made in Iceland. Scottish Highlanders put a cross of rowan wood over their stable doors to keep their cows in milk, for no witch would enter where this cross was placed. To keep cattle doubly safe, hoops of rowan were made and the crows driven through them on the way to the stable. It is said that good fairies are kind to children who carry rowan berries in their pockets, for these berries may at one time have been prayer beads. Mountain ash trees near Druid monuments give rise to a belief that it was sacred.

Colorado has a native mountain ash, *Sorbus scopulina* Greene, which grows on cool, moist slopes from the foothills to the subalpine. It is a large shrub, easily recognized by its pinnately compound leaves, clusters of white flowers, and red berries. It is one of our most beautiful native shrubs.

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Sorbus aucuparia L.

Primroses in Colorado

Panayoti Peter Callas

When primroses are mentioned, Colorado gardeners are likely to think of England or our own Pacific Northwest where these are grown so widely and so well. A number of local gardeners have tried and succeeded with quite a number of primroses in especially suitable sites, but for the average Colorado garden, primroses mean a few spider-mite infested clumps of *Polyanthus* purchased in the spring in a flat from a local grocery store that rarely survive to bloom a second year. The one almost insurmountable obstacle to growing primulas is the classic English primrose itself: *Primula vulgaris* Hudson and its multifarious *Polyanthus* offspring are simply not suited to our dry air and omnipresent sun. The famous primrose of English song and folklore may be practically a weed over much of Europe, but it is rarely long lived, even in humid climates. The rather cabbagey leaves are prone to spider-mites during hot or dry spells — and if the weather is both hot and dry the plants invariably are infested beyond recovery.

Mr. Callas has been a teacher in the Boulder, Colorado School District. He has written articles for the American Rock Garden Society publications, and *The Green Thumb*. He is secretary of the Colorado Native Plant Society, and is especially interested in horticultural alpine species and hardy perennials.

If you can overlook this pervasive species and its hybrids for a moment you will find dozens of easier, more reliable, and far showier members of this giant genus that should be in our gardens. Virtually all of the four hundred odd members of the genus *Primula* are either alpine or woodland plants. None will survive without some forethought in preparing their site and irrigation during warm spells. It is only fitting that primulas feature in the cooler microclimates of our gardens for nowhere in America do primroses form a more conspicuous component of the landscape than they do in our mountains.

The fairy primrose, *Primula angustifolia* Torr., blooms in the alpine tundra in the state in June while there hardly seems to be a single subalpine freshet in the state that doesn't boast at least a few giant clusters of Parry's primrose, *P. Parryi* A. Gray. There are even a few somewhat rare and inconspicuous bird's eye primroses in the state: *P. incana* M. E. Jones and *P. egaliksensis* Wormskj. can be found in a few of the mountain parklands. If you consider that, aside from Alaska, there are only a few very local species of primula found over most of America we can be justifiably proud of our local bounty. This wealth is best left in the

mountains for all to enjoy, for our Colorado primroses are noted for their difficulty in cultivation. If you must try these or other wild species of primula, attempt them only from seed. Collected primulas rarely reestablish in the garden — and rarely bloom if they do survive in our lowland gardens. Wild populations are finite.

How can you grow primulas in Colorado? This depends partly on the sorts you may wish to grow and the nature of your garden. The widest assortment will grow in a cool site — the north side of a building is ideal — where the soil has been spaded from six inches to a foot in depth and enriched with humus and sand. A rich, kitchen garden soil is ideal for most species: a soil that

is friable, well-drained, and never bone dry. The precise acidity of the soil matters little to most species. If you are lucky enough to have a stream or a pond many primulas will thrive and naturalize in such a spot, but even such famous moisture-lovers as the *Candabra* and *Sikkimensis* primulas can be grown well in less watery sites. Mountain primulas (of the *Auricula* section) and many of the Japanese and Himalayan alpine species are perfectly suited to rock gardens. In a rich soil leavened with sand and stone chips they will often cascade down rock faces and grow for many years with no fuss or bother.

The prime ingredients are therefore a rich soil, moisture, and coolness. A



Primula hirsuta All.

mulch of compost and leaves is an excellent way to maintain these conditions. Mulches are far more important in our dry climate than is normally recognized. Woodland primulas almost demand a top-dressing of leaves in the fall to help them through our dry, windy winters, but a half-inch mulch of decaying leaves does much to insure a cool root run for the summer and maintain soil moisture and coolness. Pine and spruce needles are ideal, for these never pack and can be left to decay and enrich the soil with time. Rock garden primulas seem to enjoy an inch-deep pea-gravel mulch which cools the soil and encourages root-growth. The precise nature of the mulch will depend on the site and the kind of primulas grown. It should not be overlooked.

What primulas will grow in Colorado? Such a small percentage of the genus has been tried that it would be foolhardy to say dogmatically that only this or that should be tried. Any gardener can add to the list with little effort in a few years, and the scope for pioneer work with the genus is vast in this region.

Because so many primulas resent the damp winter conditions in England, the Pacific Northwest, and the Eastern Seaboard, it is likely that many Himalayan alpine primulas will grow better here than in the sea-level regions where they are more often attempted. Our dry summers will be a stumbling block for certain groups of primulas that demand humidity — but even these will grow better in our climate than in the hot, muggy regions east of the Mississippi where they are often literally parboiled. Of the various species that have been attempted, certain natural groupings — or "sections" — stand out:

1. Vernal Primroses (the Vernales Section)

This section includes the common primrose and *Polyanthus* hybrids that

are so often sold in local nurseries. If the most widely available sorts are not ideal performers in our climates, other members of the section are. While not as showy as the true primrose (*P. vulgaris*), the nodding yellow clusters of the cowslip (*P. veris* L.) and the variable oxlip (*P. eliator* (L.) Hill) are both more resistant to spider-mite. The foliage of both resembles the common primrose — and is often evergreen in the oxlip. Both are sturdier and longer-lived plants than the primrose. Far more important to our climate is the tiny Caucasian primrose (*P. juliae* Kusn.) and its many hybrids with the other vernal primulas. These hybrids are called Julianas, and most are lower in stem and more vigorous than the common primrose. Their range of color is as varied as any primrose and more and more of these Julianas are developed every year. They like the same cool site as most primulas but tolerate somewhat more exposed spots. They sometimes spread by short underground stolons and do not need to be as frequently divided in order to stay fresh and healthy. The type species (*P. juliae*) is worth growing. It forms tiny rosettes with round leaves barely an inch across that rapidly form broad mats. It is covered with magenta flowers in April.

P. abchasica D. Sosn. is another sturdy, rose-flowered vernal primrose that has recently been introduced into American gardens. It is reputed to be the most vigorous and disease-free of all the section, blooming prolifically both in spring and late fall. Seedlings have survived their first winter in Colorado, and promise to be very floriferous their second year.

2. Mountain Primroses (the Auricula Section)

Why are auriculas so little grown? The garden and show auriculas are

among the most dramatic of all hardy plants with beautiful, highly varied evergreen foliage and an unbelievable variety of blossoms in every conceivable color. The auriculas are ancient garden plants that have been evolved over centuries of hybridizing from almost all the wild species of this section that grow exclusively in the European mountains. They are all bone-hardy and grow with far more vigor and permanence in our gardens than the ubiquitous vernal primulas. A number of Colorado gardeners over much of the Front Range region have assembled large collections of these auricula hybrids. They are easily divided, but take several years to bloom from seed. The infinite complexity of garden auriculas deserves a book — not a short note. The few I have tried are excellent garden plants.

The ancestors of these hybrids are distinctive plants of a different sort of charm. The mountain auriculas are usually small plants that often bloom poorly in lowland gardens. I have not found this to be the case in Colorado. The variety of blossom and foliage is

awesome among the different species — but a few stand out as exceptional plants for our gardens.

Primula marginata Curtis is a startling plant. In nature it is restricted to cliffs in the southern Alps where it forms large — almost shrubby — mats of long rhizomes that are beset with rosettes of silvery leaves that are fantastically toothed and notched. A silver line of farina often outlines the edge of the leaves — which is responsible for the Latin name. The flowers are usually of a deep lavender bloom and quite fragrant. Placed in a vertical crevice of a rock garden, *P. marginata* will cascade in time and smother with trumpets throughout April. This has proven durable in our climate.

Primula hirsuta All. is one of the most widespread Alpine species. It has evergreen rosettes of deep green, hairy leaves that slowly spread to form fine clumps that cover with pink, red, or purple flowers in April. This species has many close relatives: *P. viscosa* All., *P. villosa* Jacq., *P. pedemontana* Thomas, *P. integrifolia* L., and many more — not



Primula juliae Kusm.

to mention dozens of wild hybrids. Few of these are available from even specialist nurseries in America (although they are popular plants in England and the Continent) and American enthusiasts most usually raise them from seed. Seed of this section requires stratification and takes several years to produce a blossoming plant — but the wait is worthwhile. Seed is available from the Seed Exchanges of the American Primrose Society and other Rock Garden Societies. Perhaps with time local nurserymen will discover the charm of these plants and they will be more widely available.

There are a few European mountain auriculas of almost mythical fame: *P. minima* L. is abundant over most of the Alps but a difficult garden plant. It has tiny, toothed rosettes that often form extensive colonies. The bright rose flower is many times the size of the leaves. *P. allionii* Loisel is a narrow endemic of the southern Alps that is firmly established in cultivation. It is invariably grown in Alpine Houses in England so that winter moisture will not rot the downy rosette of leaves. Ignorant that this is considered an impossible plant, I planted my one clump out of doors where it has weathered three Colorado winters with no damage and produces a wealth of inch-wide, pure pink flowers in April.

There are many other species in the auricula section — not one of which is unattractive. Why aren't they grown?

3. Bird's Eye Primulas (Farinose Section)

The third group of European primroses is perhaps less important than the first two. The bird's eye primulas are mostly tiny plants with bright pink or rose flowers on short stems above narrow leaves covered with white or gold powder. They extend across Europe, Asia, over much of North

America and even crop up in southernmost Patagonia (*P. magellanica* Lehm.). Not only is the farinose section the most widespread — it also contains the largest number of species in the genus. Most of these are too small or transient to be considered garden plants — but *P. frondosa* Janka is quite sturdy and has thrived over many years in Colorado. It is the sturdiest of the bird's eyes and resembles some of our American species. It enjoys any cool aspect and should be frequently divided to maintain its vigour. *P. rosea* Royle is a Himalayan bird's eye with intense pink or rose flowers that demands a moist site. It has not prospered in my dry garden, but its hybrid — *P. x 'Peter Klein'* is quite permanent in a moist corner (*P. rosea* x *P. clarkei* Watt). *P. luteola* Rupr. is a Caucasian species with smooth rosettes of bright green, deciduous leaves that produces its flowers in late June and July. Remarkably, these are yellow and quite showy. I found this difficult at first since it resents excessively moist spots and will rot unless perfectly drained.

4. Denticulate Primulas (Denticulata section)

Only one species in this section is commonly grown. *P. denticulata* Sm. is a genuine mystery: how could such a striking plant with such distinctive flowers and an indestructible constitution be so little known? Sometimes called the drumstick primrose, it produces several stalks of flowers its first year from seed that emerge from a fat resting bud in the earliest spring. The flowers are congested in a perfectly spherical head three or more inches across that emerges very early in the spring (often in March) and continues to elongate throughout April and May. The leaves are delicate and deep green, often toothed along the edges, but elongate to

form a large, cabbagey mass of verdure during the summer months. Because of this, the drumstick primula should not be planted among tiny plants, but grown in wide swatches by itself. Any cool, shady spot is ideal — in fact, I have been forced to move mine to less and less favorable positions because it self-sows vigorously in my garden. This is an excellent primula to begin with in Colorado, for it is long lived, easily divided, and very showy. Rose, purple and white forms are common — but one Denver garden possesses the finest form of all: half the size of the common species, in Kashmir the drumstick primrose is often powdered with silver farina. The flowers of the superior form are a cool lavender.

5. Geranium-leafed Primulas (Section *Cortuseoides*)

This section contains some of the most vigorous and beautiful primroses. They are invariably of a strong constitution and moreover will stand more drouth and abuse than any other section of the genus. The geranium-leafed primroses are mostly deciduous, but as the common name implies, the foliage is quite different from the better known sorts. *P. sieboldii* E. Morr. comes from Japan and Eastern Asia and must rate as one of the finest of all garden plants. It produces its jagged and furry leaves in April, with many 8 inch stalks of flowers following in May. The variety in color, flower shape, and leaf form is astounding. Blues, pinks, purples, and whites are common in cultivation — but the Japanese have produced a tremendous variety in petal form through centuries of hybridization. Snowflake patterns are common, and no two *P. sieboldii* seedlings are the same. This will thrive in any cool spot, quickly forming wide mats. The foliage dies down quite early in the autumn, so

it should be marked well. *P. cortusoides* L. and *P. saxatilis* Komarov are similar in foliage, but produce rose flowers of a smaller size. There are a score or more other species in this section, many of which have proven hardy over the last few years, and all of which are beautiful. This is a group that deserves wide attention in Colorado because of its preference for drier sites in nature.

Miscellaneous Asiatics

More than three hundred species of primulas are found in the giant mountains that make up the heart of Asia. Many more undoubtedly lurk undescribed in the little explored fastnesses of this region — and those that have been introduced, especially during the first four decades of this century, were often fleeting or of "Botanical Interest Only." So many thousands of species of plants were collected in such a short space of time that few found a foothold in cultivation during this period, and since China and Tibet have become difficult of access to horticulturists the bulk of the genus is out of reach. Nevertheless, the desire to live is such that many Himalayan primulas did survive the shuffle of introduction and are commonly found in English gardens. Seed from England has spread throughout the world and many Himalayan species are now more common in gardens than in the wild. Two sections of Himalayan primulas commonly grown in England are difficult in Colorado: *Nivales* and *Petiolaris* primulas comprise dozens of species that demand a constantly cool, moist atmosphere to thrive. These should be attempted only by gardeners who are ideally situated in the foothills or insensitive to watching plants die.

The Sikkimensis primulas are another proposition. If you have a deep, rich soil in a northern exposure and are willing

to water liberally during hot spells, *P. alpicola* Stapf in blue, white, or yellow will establish easily from seed and quickly form large clumps. The ethereal, freely produced bells on 15" stems are intensely fragrant. Like all its close relatives, the moonlight primula of Tibet enjoys our dry winters and is slow to emerge in the spring. The flowers don't bloom until June and *P. sikkimensis* Hook. often blooms in July. This and *P. florindae* Ward are giant plants — often three or four feet tall — and look and grow best along streams. Their gargantuan stature makes them plants for big gardens, but small gardens are amply recompensed by *P. alpicola* and a few other dwarfs.

P. reidii Duthie and *P. nutans* Delavay are not easy plants to grow. They are among the most unearthly and beautiful of all garden flowers. In England they are regarded as biennials and generally relegated to Alpine Houses because of their fierce resentment of winter wetness. I have been amazed to find my few clumps living for three years and showing no sign of decreasing vigour — and I am beginning to suspect that Colorado might be the perfect home of exile for these gems of the *Primula* genus. Both spring from tiny resting buds in the late spring and quickly form rosettes of small, fleecy leaves covered with down. The stems rise to 5 to 6 inches and produce wide bells of white or lavender that are intensely fragrant and of a haunting, translucent texture. They grow quickly from their dustlike seed and often bloom the second year. These hold great promise for primulas in our climate.

P. capitata Hook. resembles a dwarf, summer-blooming drumstick primula. It too is Himalayan and regarded as a monocarpic or biennial plant, but it also has persisted and flourished after blooming in Colorado. It is one of the latest of all primulas — some forms do not bloom until autumn.

Primula japonica A. Gray is the best known member of the candelabra section of Primulas — most candelabras come from the Himalayas. All grow easily from seed, but are of such a large stature that they should only be grown in large gardens. Most bloom the second year from seed and none is very long lived, but I have yet to grow a candelabra that didn't survive a Colorado winter. They produce a large rosette of leaves often a foot in diameter and a central stalk that produces tier after tier of whorled flowers in pink, red, white, or yellow. If happy these will self-sow wildly and do not necessarily require a stream or pond to flourish. None of the candelabras is especially choice or difficult, but all are worth growing in a cool or moist site for their showy display.

This has barely skimmed the surface of one of the most rewarding groups of garden plants. Those who claim that primulas will not grow in Colorado have either not tried them or have been afraid to leap into the floriferous ocean of *Primula*.

REFERENCES

Many books have been published about primroses over the years — especially pertaining to their culture in England and Europe. Specialist nurseries and societies like the American Primrose Society are an excellent source of information on their culture and sources for plants or seed. A few of the books I have found especially useful are:

- American Primrose Society: *Pictorial Dictionary of the Cultivated Species of the Genus Primula*. lavishly illustrated, this inexpensive paperback is available from the Society Secretary.
- Green, Roy, 1976. *Asiatic Primulas*, Alpine Garden Society, The Compton Press Ltd., Wiltshire.
- Halda, Joseph. 1975. *Primulaceae: II, Rod Primula*. Klub Skalníckaru, Prague, Czechoslovakia. (In Czech, but worthwhile for the beautiful drawings by Jarmila Haldova.)
- Klaber, Doretta, 1966. *Primroses and Spring*, M. Barrows and Company, Inc., New York. Excellent guide for beginners — especially written for conditions in America.

Jack Riley

Sometime in the late fifties I met Jack Riley and his wife, Kay, at an American Iris Society convention. They have attended almost all of them ever since. Most of us have known people in the Iris Society who have decided that their irises needed more space, and dug up a whole lawn. But how many irisarians do you know who decided that irises were more important even than a whole garage? Jack's son, Bob, told me how he helped his Dad take down the garage and prepare the ground.

Jack grew all kinds of Irises, the species — *Iris balkana* Janka, *I. barthii* Prodan & Buia, *I. Pumila* L., *I. montana* Goodd., and *I. missouriensis* Nutt. are a few that readily come to mind. He also grew many different cultivars of spurias and siberians, tall bearded, favorites. He even hybridized a few — Ginger Tart — a brown plicata Standard Dwarf Bearded introduced by Melba Hamblen in 1970, and that little brown nugget — Little Dandy — are two of his best. The Riley garden generally had some iris blooming in it from late March until the 4th of July with a few interruptions from unexpected snowstorms and a bit of hail. But no matter when you went you were never disappointed. Jack was a superb photographer and always had his projector ready. If you couldn't find an iris in bloom the day of your visit, just wait a minute, Jack was sure to have a slide of it; in a jiffy, it was on the screen. No wonder this was the most popular Median Iris Display Garden for miles around.

I moved to Colorado in the summer of 1971. I bought an acre of ground and set aside a quarter of it for a future iris garden. Jack was over quickly to survey the place. Good drainage on a gentle

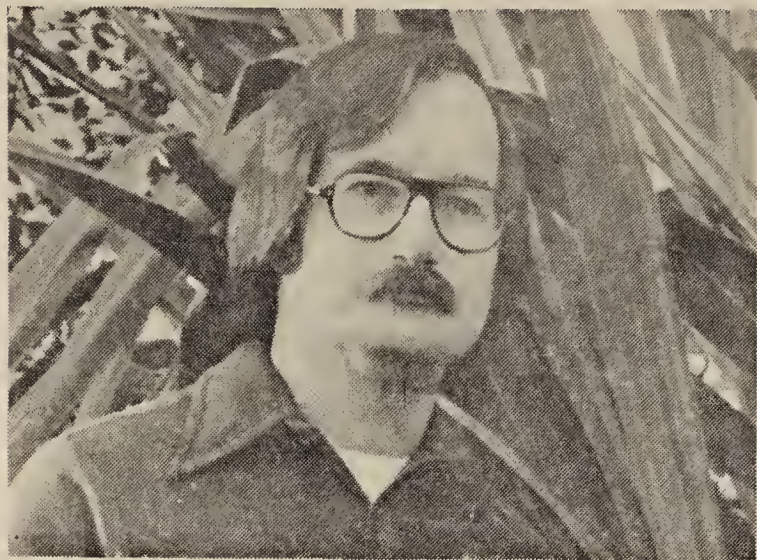
slope, but hard pan and gumshoe clay made iris planting a dismal project. Not for Jack. He quickly found a farmer, and a plow, and the ground was soon tilled to proper planting depth. The iris we planted that summer liked it too. By 1973 they were thriving. Jack taught me to divide newly planted iris rhizomes wherever possible to protect against winter losses. Botrytis is their worst enemy in the Rockies. It rarely hit a whole clump divided at planting time.

Jack and his son, Bob, had a lot to do with the planting of "guest irises" for both the 1963 and 1967 AIS conventions at the Denver Botanic Gardens. In between these years, he ably served AIS Region 20 as its Regional Vice President. After the convention and ever since then, Jack made the dwarf and median beds at the Denver Botanic Gardens his special project. He founded the hemerocallis display garden there too. The planting was annually updated with new varieties, and the plants were always properly weeded, watered, and labeled at bloom time. A special memorial fund has been set up at the Denver Botanic Gardens to perpetuate our appreciation of his contributions to the betterment of irises and daylilies there. He was equally active in the affairs of the American Hemerocallis Society and served as RVP for the Rocky Mountain Region from 1975-1977. He was a Senior Judge in the American and Dwarf Iris Societies. He was also an awards and honors and exhibition judge of the American Hemerocallis Society.

Jack was a warm, friendly, knowledgeable and thoughtful man who made this world a better place by his presence. We will miss him and cherish his memory.

Harry Kuesel

New Assistant Director



Merle M. Moore

The Denver Botanic Gardens is pleased to welcome Mr. Merle M. Moore of Ann Arbor, Michigan as its new Assistant Director. Mr. Moore took up his new duties on August 14, 1978. Glenn M. Park, who had been serving as Assistant Director, resigned in early February 1978 and is now the proprietor of a nursery in Riverside, California.

In Ann Arbor, our new Assistant Director had been serving as the Senior Horticulturist of the Matthaei Botanical Gardens at the University of Michigan since 1974. Previous to his tour of duty in Michigan he held the position of Assistant Horticulturist at the Holden Arboretum in Mentor, Ohio. Of special interest is Mr. Moore's experience as an advisor on civilian programs to the Vietnamese government on the District and Province level. His position was with the U.S. Agency for International Development operating out of Washington, D.C. Earlier, as a Peace Corps volunteer, the new Assistant Director served as agricultural advisor for Peace Corps volunteers working with various Hill Tribes in remote areas of Thailand. Before his government service, Mr. Moore spent a period as a Managerial Trainee at the Wayside Gardens Company in Mentor, Ohio.

The Botanic Gardens' newest staff member holds a Bachelor of Science degree in Landscape Horticulture from Michigan State University where he also

completed one year of graduate study. Mr. Moore then spent a full year studying Vietnamese language and culture at the Vietnamese Training Center, Foreign Service Institute in Washington, D.C.

At the Matthaei Botanical Gardens, Mr. Moore was responsible for the management and supervision of all horticultural operations of the gardens. He was responsible for making decisions on all matters concerned with the growth and propagation of the plants in the various collections in the gardens as well as designing and directing the development of new plantings. Additional duties there were concerned with supervision of all garden personnel and preparation of the budget for horticultural operations.

Members of the Denver Botanic Gardens will be interested in learning that Mr. Moore was responsible for setting up a membership organization for direct support of the Gardens' development and that he formed also the organization of volunteers there known as Friends of the Matthaei Botanical Gardens (which now consists of more than 400 members). At both the Holden Arboretum and the Matthaei Botanical Gardens he set up intensive programs in the field of horticultural therapy for the operation of which he was able to obtain financial grants. His interest in horticultural therapy extends over a long period; he is currently Vice President of the Board of Directors of the National Council for Therapy and Rehabilitation Through Horticulture. Other professional organizations of which he is a member are the American Association of Botanical Gardens and Arboreta, the American Horticultural Society, the Royal Horticultural Society (England) and the Garden Writers Association of America.

Mr. Moore is married and has three children. He and his family have taken up residence in Littleton.

William G. Gambill Jr.

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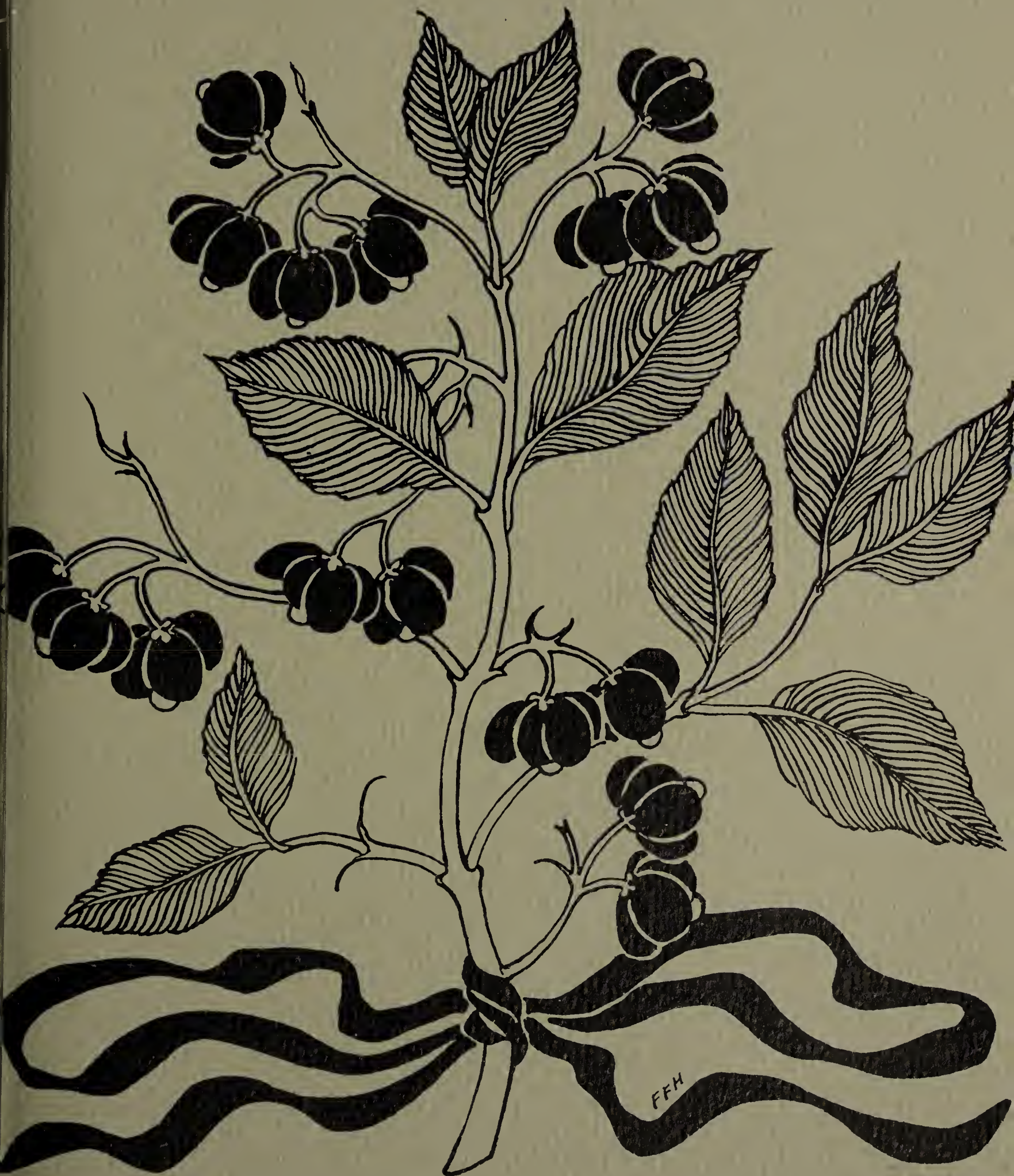
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THE COVER

Christmas *Euonymus*

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For further information write to Membership Chairman, Botanic Gardens House, 909 York Street, Denver, Colorado 80206, or call 575-2547.

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William H. Anderson, Jr. Ed.D.
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Perennials for The Local Garden

Andrew Pierce

It was with some misgivings that I accepted the task of revising and bringing up to date the fine article of Bernice Petersen's on Perennials (*Green Thumb*, Vol. 21, No. 1, 1964) written when space shots were a novelty and men in space for 100 days or more a future hope. My angle may be somewhat more practical but I feel people have reached the stage of considering their garden values more than ever before.

Today, perennials are making a comeback as more people realize that it's great to have your plants come up for you in the spring instead of having to hassle over purchasing, protecting, and planting annuals. One may almost say these three "Ps" are turning people to perennials, but there is still room to adopt annuals in moderation in the perennial border. More of this thought later.

It would not be out of place to state that perhaps 999 people out of a thousand have no idea of the range of perennial plants available to beautify the garden in the longest succession of color for any border. One English authority claims to have 5,000 different varieties and species in his own garden and nurseries. In the strictest sense of the term, perennials fall into two groups: (A) Woody — such as trees and shrubs that have a persistent stem and (B) Herbaceous — whose foliage and stems in the majority of cases die down to the ground each fall with ensuing regrowth in the spring. This will be our principal group of concern, but accent in any border can be given with the judicious use of the occasional individual shrub or clump of more persistent perennials such as *Iberis* (candytuft) whose framework exists above the ground from year to year.

Perhaps nowhere in the garden does planning have more opportunity to show its flair or for that matter have more chance to fail than in the design of the perennial border. When one starts to list the variables that are not only offered but need almost to be adhered to, he begins to question the practicality and the use of this wide-range group of plants. For the moment let us put some of the ideas down. Start with the earlier statement — period of flowering: taken literally, perennials start off with the earliest of crocus right through to asters and *Heleniums* of the late fall. Of course you may not consider crocus as a perennial, but for ultimate range of season they are and should be included. Likewise, there is the beauty of fall foliage in such plants as the *Epimediums* and occasionally peonies which extend the season even further. Next, to

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color — a perennial planting can include hues as wide as the rainbow in what may be a relatively small area. The early yellows of *Doronicum* (leopard's-bane) can be followed by bleeding hearts, with their delightfully perfected pink and white flowers, the blue spires of *Delphiniums*, rich whites of shasta daisies, followed by the pink into the sunset range of the *Phlox*. Magnificent spikes of red hot pokers reflected in dainty beds of *Gypsophila* follow, then autumn hues of sneezeworts and cone flowers, and a final burst of pink asters and lofty Japanese anemones. Does this not give you the idea of complexity when planning a perennial border? We have yet to cover shape, form, height, and color of foliage.

Height is one of the factors that creates uniqueness of a border. When planning you should never have the back row or the front at exactly the same level. Create variation with the odd subject coming forward so that you cannot completely view a border or site planted with perennials. This accent can, of course, be the individual shrub mentioned earlier or it may be a taller group of plants such as *Delphiniums*. These plants in turn may be taken advantage of as they establish microclimatic areas for partial shade lovers, so extending the wealth of material that can be planted.

In Praise of Perennials

It may be apt to title this article so and given the correct treatment perennials can indeed be praiseworthy.

Mistakes can, of course, be made, but careful thought and the endeavour to hunt for that right shade of *Iris* or *Achillea*, the heavy foliage of the *Clematis* or fairy feathers of *Thalictrum* give a tremendous range of beauty and delight to pursue. Firstly, I, for one, will not question that annuals are colorful and in many instances are the turn-on of a garden when correctly planted, but for subtle beauty with daily freshness, range of color, and opportunity to pick for that rush dinner party, perennials are necessary. Additionally, the architectural heads of *Echinops* and *Eryngiums* make marvellous Christmas decorations.

We talked earlier about annuals in the perennial garden and after the spring clumps of crocus, tulips, and the like have passed away careful placement of a few suitably colored annuals such as petunias, phlox, everlastings, and verbena can be incorporated to bridge gaps between the earliest bloomers and the first perennials. This is also true for some of the early herbaceous plants such as *Doronicums* and forget-me-not whose beauty fades with the rise of the summer sun. There are other flowering bulbs such as the almost soccer-ball sized ornamental onions and the glorious foxtail lilies which in their turn add interest and elegance to the border. Where there is some shade or where the plants can be given cool roots, lilies can be used. This group of plants, though of somewhat shorter flowering period, add a wealth of beauty. Unfortunately they are all too infrequently used in our region — people fail to take the opportunity offered with such a rewarding group of plants.

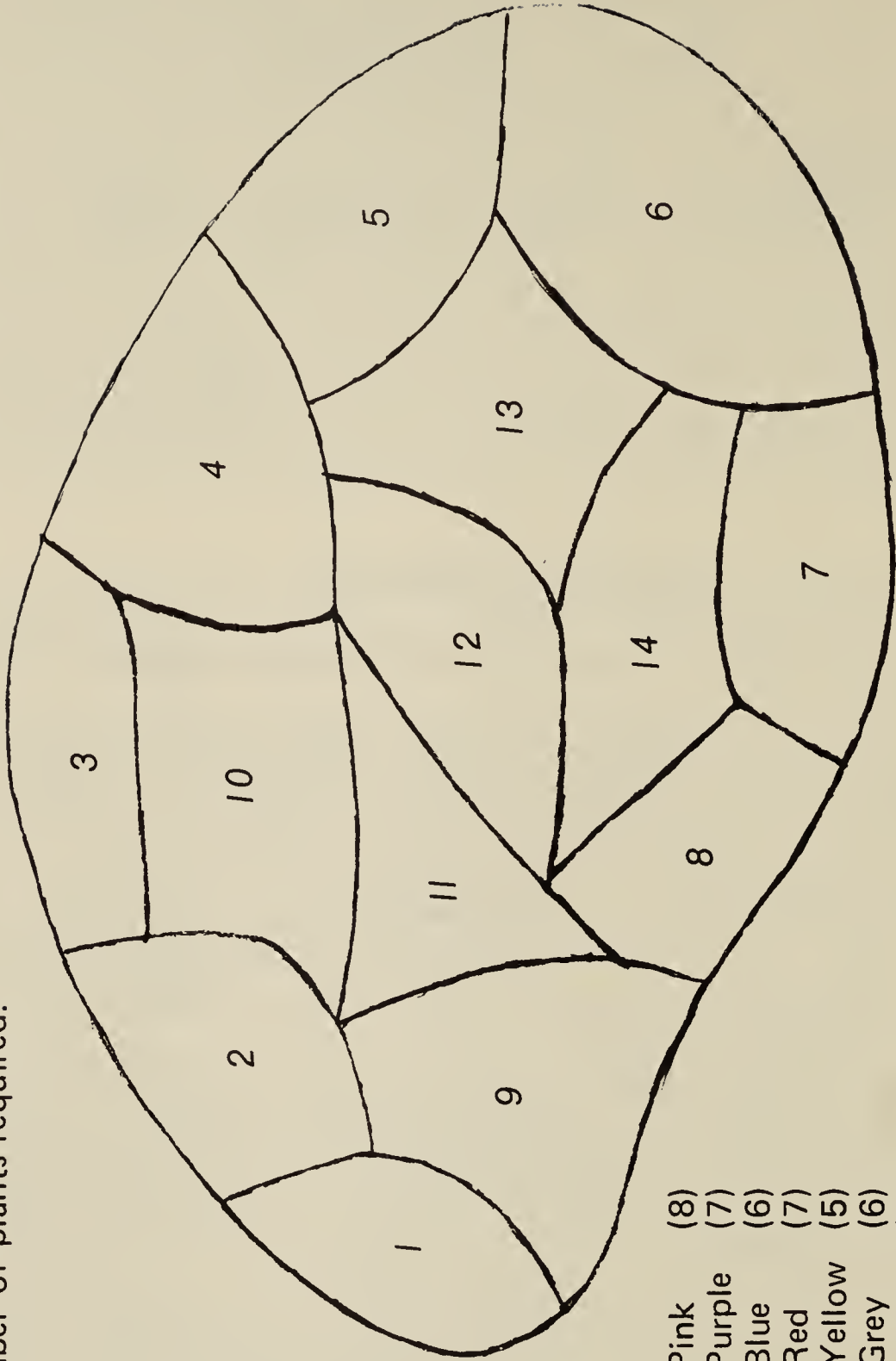
Soil Preparation and Planting

With any plant that is going to be in a selected spot for a number of years it is essential to give your soil adequate preparation — like the tree that is going to be with your landscape for years to come. Deep digging, preferably double, should be done, drainage in the form of tiles or more modern plastics may be installed should the ground require it. Adequate dressings of compost, manure, and peat moss should be incorporated to bring your soil up to a friable healthy condition for the expected

SUGGESTED PLANTING SCHEME FOR AN ISLAND BED

18 X 10 feet approx.

Numbers in () refer to number of plants required.



- | | | |
|---|--------|-----|
| 1. <i>Dianthus semperflorens</i> | Pink | (8) |
| 2. <i>Veronica incana</i> | Purple | (7) |
| 3. <i>Aster Dwarf type</i> | Blue | (6) |
| 4. <i>Geum 'Mrs. Bradshaw'</i> | Red | (7) |
| 5. <i>Oenothera missouriensis</i> | Yellow | (5) |
| 6. <i>Stachys lanata</i> | Grey | (6) |
| 7. <i>Euphorbia polychroma</i> | Yellow | (5) |
| 8. <i>Sedum spectabile</i> | Pink | (6) |
| 9. <i>Campanula glomerata</i> | Blue | (7) |
| 10. <i>Phlox paniculata 'Starfire Red'</i> | | (4) |
| 11. <i>Delphinium elatum</i> | Blue | (3) |
| 12. <i>Sidalcea 'Rose Queen'</i> | Rose | (3) |
| 13. <i>Rudbeckia triloba</i> | Gold | (4) |
| 14. <i>Chrysanthemum maximum 'Alaska White'</i> | White | (5) |

sojourn for several years to come. Occasionally very heavy soils may require additional sharp sand and small gravel to improve drainage even further.

You may be wondering how often replanting should be done? In the case of peonies, Japanese anemones, bleeding hearts, and Christmas roses it seems the longer they are left the better they fare, but at the other end of the scale strong growing Michaelmas daisies (*Aster*), *Heleniums*, and *Chrysanthemums* may require division every other year. (Here's the chance to be friends to your neighbors!)

When to plant? Generally there are two main periods. Here in Denver, if the weather is open, late September and early October and again in May or early June. With the spring pressures of work, fall planting with some winter protection is certainly worth consideration. Additionally, soil preparation may be easier at this time than after a heavy wet snow in May.

Planting is often done from containers. These are set in the ground in the usual fashion making sure they are firm and just deep enough. Other subjects such as peonies and *Baptisia* (false indigo) are planted deeper and instructions from the wealth of books available should be checked. Many items like phlox, Michaelmas daisy, *Helenium*, *Liatris*, and *Achillea* produce large clumps of surface rooting crowns and in no instance should they be planted too deeply. Water-in adequately after planting and again in a few days if no rain falls. It goes without question that your planting soil should be free of weeds, especially perennial ones such as bindweed, and careful cleansing during the first season is an absolute necessity.

Planning Your Group

Usually planting is done in groups of say three, five, or even ten for small ground cover types. Much will depend on the location, size, and exposure of the area involved. It is quite possible that your area will be exposed to the sun all day as is the case of an island bed set in grass, perhaps one of the most delightful locations, or in the shade of your house amongst more permanent plantings. In the latter, plants of Christmas rose, *Astilbe*, *Epimedium*, *Pulmonaria*, and *Vinca* may be extremely suitable, but to put them out in the full sun is to court disaster. Choice of plants should be explored very carefully — talk to people who know; keep your eyes open at other gardens; and perhaps most important, consult books, catalogs, and garden magazines. Today's trends are very different from yesteryear's but even though nurseries are few that deal in perennials they are worth looking for. Locally there is one but I understand that a second will be retailing perennials perhaps next year. Mail orders can, of course, be easily shipped, but there is nothing like seeing a plant *in situ*. Unfortunately with a disturbing frequency, beautiful perennial plants with soft lines and delicate foliage have to contend with hard lines of concrete, heavy backyard fences, and other inappropriate conditions. It seems that man in his urge to house the masses has lost the potential to please nature. The value of basic landscaping is there, but the in-betweens of what makes a garden are all too frequently lost to the lowered cost of maintenance and the parking spot for the RV.

Many people are finding that perennials like house plants can be distributed readily among friends and neighbors, and if you have propagating facilities very many perennials can be readily grown from softwood cuttings. Once plantings are established, division is the usual process and over-the-fence handouts can soon be seen growing along a street. A few, such as bouncing Bet (*Saponaria officinalis* L.) and bluebell (*Campanula rapunculoides* L.) can be pernicious weeds, and any distribution calls for the art of self control in one's own border.

What of the Future?

A few years ago *Achillea* or yarrow came only in yellow and white but now there are delightful shades of pink and rose. Two of our native plants *Tradescantia* (spider-worts) and *Monarda* (bee balm) now sport a wide range of color including white. The color range of phlox has always been extensive but have you looked at the hues of oriental poppies lately? They come in any color from white to the deepest of red with both single and double forms. Little *Geums* and *Potentillas* do much the same, and with the plant breeder always looking out for the unusual I have no doubt that we will be seeing pink *Delphiniums* and red *Coreopsis* in the future! A couple of other groups that are perhaps not utilized enough here in our area are *Centureas* and *Asters*. One other group of plants that up to now we have neglected is grasses, and whilst not great in numbers for our purpose their use for accent is tremendous. For example the tall waving fronds of plume grass ideally suit the back of the border whilst the front can be accented with clumps of blue fescue.

So the story goes on. It is extremely difficult to cover the range of material available, perhaps over 300 taxa in our area alone. This means the use of illustration and other people's efforts is of prime importance. Here at Denver Botanic Gardens a first major effort at perennial borders is being made and next summer the north end of Linden Allée should show some of the results of several continuous months of work, both in the planning and planting stages. Our efforts will not be perfect in the eye of all beholders but we hope to illustrate as wide a range of material as possible. Shade lovers and those requiring less light will be featured around the Botanic Gardens House. We will try to show good color combinations, types of foliage be they grey, green, or fluffy, and the longest blossom period for this exposed site. Background and height of the adjacent shrubs will play an important part in the choice of plants. We hope to illustrate both the well known along with rarer Maltese cross (*Lychnis*) or prairie mallow (*Sidalcea*). Native *Tradescantia* and golden rod will, of course, play their parts, but it is not the intention to transpose the extreme wealth of native and endemic material from its natural grandeur.

Below are lists of suggestions but please take them as such. Perhaps nowhere in garden planning will people differ more than in perennials, and nowhere in your garden will plants be more decorative. Given the passage of time and the ultimate cost of annuals, perennials should and will be used more.

Suggested Lists of Perennials for Various Locations

Generally all of the genus succeeds in the given location unless specified.

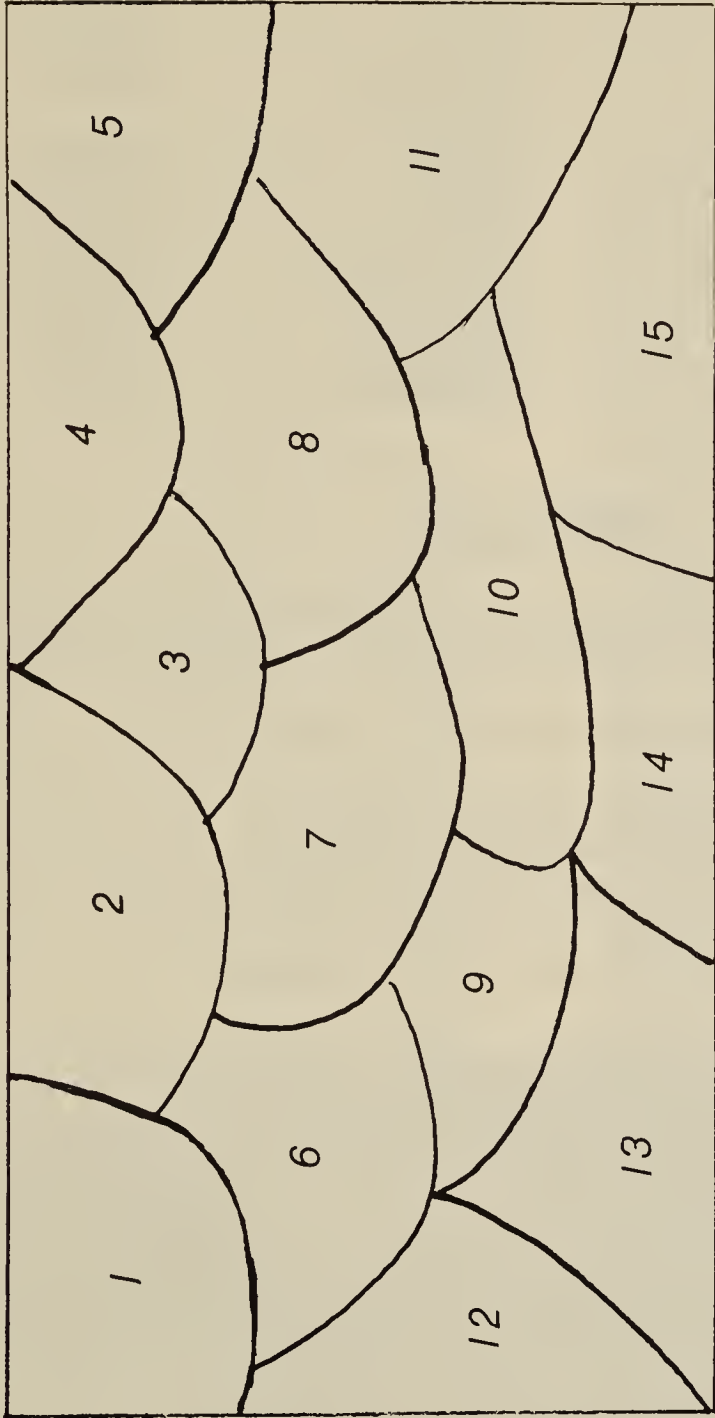
Ground Covering Types

Achillea millefolium
Ajuga
Anaphalis
Armeria
Asperula
Campanula muralis
Cerastium

Dianthus
Epimedium
Festuca ovina glauca
Gaillardia — dwarf
Pachysandra
Phlox subulata

Potentilla — some
Pulmonaria
Sedum — various
Stachys lanata
Veronica — dwarf
Vinca

SUGGESTED PLANTING SCHEME FOR A BORDER 8 X 16 feet.



Numbers in () refer to the number of plants required

1. <i>Rudbeckia triloba</i>	Gold	(4)	9. <i>Scabiosa caucasica</i>	Blue	(5)
2. <i>Delphinium elatum</i>	Blue	(3)	10. <i>Pyrethrum coccineum</i>	Mixed	(6)
3. <i>Papaver orientale</i> 'Buckeye Red'	Red	(1)	11. <i>Gypsophila paniculata</i>	White	(3)
4. <i>Sidalcea</i> 'Rose Queen'	Rose	(3)	12. <i>Chrysanthemum maximum</i> 'Moonlight'	Red/Yellow	(4)
5. <i>Paeonia</i> 'Sea Shell'	Pink	(3)	13. <i>Geum borisii</i>	Red/Yellow	(7)
6. <i>Monarda didyma</i>	Red	(3)	14. <i>Stachys lanata</i>	Grey	(6)
7. <i>Phlox paniculata</i> 'Snowfire White'		(5)	15. <i>Achillea filipendula</i> 'Cerise Queen'		(7)
8. <i>Helenium autumnale</i> 'Bruno Bronze'		(5)			

Perennials that grow well in Partial/Full Shade

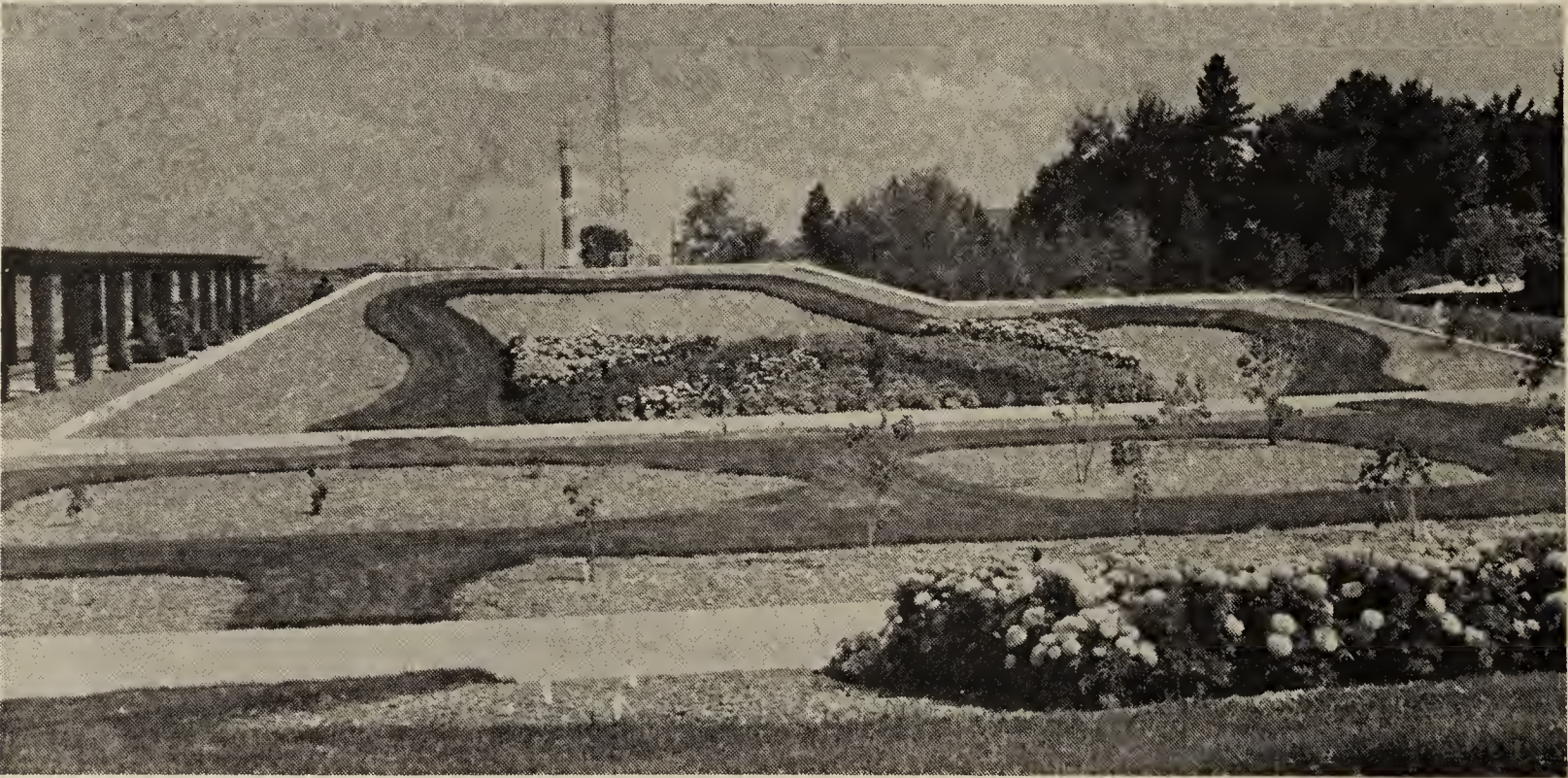
<i>Ajuga</i>	<i>Centaurea montana</i>	<i>Hosta</i>	<i>Pulmonaria</i>
<i>Aguilegia</i>	<i>Convallaria</i>	<i>Mertensia</i>	<i>Thalictrum</i>
<i>Asperula</i>	<i>Dicentra</i>	<i>Pachysandra</i>	<i>Trollius</i>
<i>Astilbe</i>	<i>Epimedium</i>	<i>Polemonium</i>	<i>Vinca</i>
<i>Bergenia</i>	<i>Helleborus</i>	<i>Primula</i>	

Perennials that will withstand Sunshine Conditions

<i>Achillea</i>	<i>Erigeron</i>	<i>Liatris</i>	<i>Salvia</i>
<i>Armeria</i>	<i>Euphorbia</i>	<i>Lupinus</i>	<i>Scabiosa</i>
<i>Artemisia</i>	<i>Gaillardia</i>	<i>Oenothera</i>	<i>Sedum</i>
<i>Aster</i>	<i>Geranium</i>	<i>Paeonia</i>	<i>Sidalcea</i>
<i>Campanula</i>	<i>Geum</i>	<i>Papaver</i>	<i>Solidago</i>
<i>Centaurea</i>	<i>Helenium</i>	<i>Phlox</i>	<i>Stachys</i>
<i>Chrysanthemum</i>	<i>Hemerocallis</i>	<i>Physostegia</i>	<i>Tradescantia</i>
<i>Coreopsis</i>	<i>Heuchera</i>	<i>Potentilla</i>	<i>Veronica</i>
<i>Dianthus</i>	<i>Iris</i>	<i>Pyrethrum</i>	<i>Yucca</i>
<i>Echinops</i>	<i>Kniphofia</i>		

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The Gardens in Bloom

Construction Started on Japanese Garden

Edward Connors

The Denver Botanic Gardens has long hoped for a Japanese garden to be part of its display area at the York Street gardens. Plans date back to 1964 for such a garden, since one does not exist on a large scale between St. Louis and the West Coast of the United States. A very interested Japanese-American community in Denver, including Ikebana International and the Denver Bonsai Club, have dreamed of the day when we might have such a garden here. Many things go against us in this area, the most important being our mile-high climate and dryness. Many of the most familiar plant types of Japanese gardens, such as azaleas, rhododendrons, and Japanese maples simply stand a slim if not impossible chance of survival in our area. But we can do well with pines, and it was this possibility which has kept the fires of hope kindled.

Specific plans were put in temporary abeyance in 1969 when the Board of Directors of the Gardens voted to create a Master Plan for the York Street Gardens. The firm of EDAW, Inc., drew up such a plan and an approximate two-acre site was reserved in the northwest corner at that time. So much expense was required to put in the initial stages of implementation, such as

Mr. Edward Connors is a vice-president of the Denver Botanic Gardens. He has been active in fund raising efforts as well as Chairman of the Planning Committee interested in the forward movement and development of the Gardens.

a complete circuit of walkways, waterways, and water system, that we could not get to the Japanese garden until June 1977. at that time all we could show for our garden was a spot on a plan and a magnificent stone lantern which had been donated by our sister city, Takayama, Japan, in the mid 1960s.

On June 14, 1977, the Planning Committee and the Executive Committee of the Botanic Gardens' Board voted to retain Professor Koichi Kawana to design and supervise construction of our Japanese garden. He was chosen for many reasons. Many American Japanese gardens are definitely "Americanized" versions and not authentic. Professor Kawana, a native of Hokkaido, Japan, is a purist and will design only authentic Japanese gardens. His list of such accomplishments is long, but most recently includes a design for the Chicago Horticultural Society's Japanese garden in Glencoe, Illinois. His major work in America, the largest Japanese garden in North America, is the 14-acre Japanese garden at the Missouri Botanical Garden in St. Louis, which was opened in 1976. He is also principal architectural associate and lecturer in Japanese art, architecture, and landscape design at UCLA, and president of Environmental Design Associates. Professor Kawana is an avid collector of Japanese art and is an accomplished painter. Thus, we feel most fortunate in having him as our

man on the spot. In the past year our good fortune has been amply demonstrated.

In August 1977, Professor Kawana presented to the Board of Trustees his initial ideas. His enthusiasm for our project was quite contagious and his ideas were heartily approved. On December 16, 1977, at a reception at the Gardens, Professor Kawana helped launch our comprehensive \$1.5 million fund drive called "To Fulfill a Promise" by unveiling his plans to the Japanese community and to the public accompanied by some of his excellent collection of slides.

A most essential element of a Japanese garden is stone, and the proper selection and placement of stone is of utmost importance. In St. Louis the stone had to come from the Rockies or the Appalachians. We are lucky, for on that cold December day Professor Kawana accompanied Director William Gambill and the writer to the foothills and beyond searching for proper rock types. Though it was chilly, Professor Kawana immediately warmed to the fact that the exact type of rock that he felt we needed was available so close to Denver, just past Golden. He said at that time, "Stone is a natural form of sculpture. Each stone must be carefully selected and even more carefully placed in the garden. Unlike most parts of America, Colorado offers wonderful choices of stone. In Japan a beautiful stone is now difficult to find and is very expensive. A garden with the properly selected and positioned stone, combined with water and indigenous plants, will give the visitor to the garden a feeling of unity with nature."

On March 18, 1978, Professor Kawana was back in Denver presenting to a distinguished representation of Denver's Japanese community at the Tri-State Buddhist Church his ideas of how they might best help in our \$250,000 project. This group was assembled largely by the help of Minoru

Yasui, Executive Director of the Commission on Community Relations of the City and County of Denver. At that time Professor Kawana's plans for a 27' x 20' Japanese Tea House which would contain an area for the tea ceremony, Ikebana flower arrangement, and Bonsai display area were unveiled. Those assembled committed themselves to personal involvement in the actual building of the garden. Mr. Yasui's help has been invaluable.

By late August ground was finally broken and the contour of the dominant lake in the middle of the garden soon took shape. Professor Kawana again came to Denver to approve of the contouring and final selection of stone. Ultimately we will require some 300 tons of



One of the Gift Lanterns

stone, but all of it will come from a site just northwest of Golden and from the Loveland area. This stone will be soon delivered to the garden where Professor Kawana will supervise the positioning of the stone. With characteristic understatement, he terms this rock as "fine."

But this past summer has seen much further flurry of activity directed toward the Japanese community. Men from the Denver Bonsai Club obtained a permit to collect suitable plant material for the gardens from the U.S. Forest Service lands and from a site near Lyons. Such selection and collection is a very difficult, time-consuming job. Some 32 character pines were dug, balled, and transported to the gardens in early summer, and have been layered in at the gardens. Their healthy survival during our record-breaking hot summer is a fine testament to the expertise of this conscientious group, and their gift is of great value. They have plans for further collection next spring.

On July 8, a delegation from Takayama, Japan, headed by their Mayor Kichiro Hirata presented to the City of Denver and to the Gardens specifically a 5 foot high Hida Snow Lantern. This 1760 lb. lantern will be a focal point near the shore of the planned lake and was accepted with many thanks by our Mayor McNichols. The generosity and interest of our sister city in Japan was a warming occasion for all assembled. Also presented at this time was an unusual copper lantern for the Tea House from the People-to-People Corporation.

Since that time we have received a five-tiered Pagoda stone lantern from Mr. G. Nakamura of Sapporo, Japan. What a delightfully appropriate and unsolicited gift, for we now have three of the five stone lanterns that Professor Kawana visualizes we will need for our garden. In the spring of 1979 the People-to-People Corporation of the City and County of Denver will be staging a six weeks' symposium in Denver on "Japan Today" with exhibits, perform-

ing arts, lectures, and films at which time the Gardens hopes to have gone a long way towards finishing our garden.

Our most recent gift has come from the Weckbaugh family of Denver. Mrs. Ella Mullen Weckbaugh was long a friend of the Botanic Gardens, and her family has given funds for the proposed tea house in her memory. As stated previously this house will be used to stage the famous Japanese tea ceremony. But in addition the Gardens already has three lovely Bonsai trees with the promise of more to come, and this collection will be housed in this building as well. On our behalf Professor Kawana traveled to Japan in September and ordered the tea house to be built in Japan; it will be reassembled at the northeast edge of the Japanese garden sometime early in 1979. Two retired carpenters of Japanese descent have volunteered to help construct this building at the garden.

Thus, many funds have been collected and generous gifts in kind have already been received to permit us to forge ahead and make our Japanese garden no longer a hope, but a reality. So many people need thanks for that which has transpired thus far. Minoru Yasui needs special thanks, as do Harold Sasaki and his men from the Bonsai Club. We will still need four gates for the garden, an arbor, two stone water basins, fencing materials, many more specimen trees and shrubs, and additional funds. But, we are well under way towards providing Denver and the West a Japanese oasis for solitude and contemplation. In the words of that talented man whom we have come to love dearly, Professor Koichi Kawana, we will have a "fine" garden.



Herb Garden Completed

Gloria Falkenberg

It is indeed a pleasure to wander in the Herb Garden today. The completion of the entire Herb Garden shows many years of dedicated commitment, work, and belief in Denver Botanic Gardens.

The development of the Herb Garden is the history of the Denver Botanic Gardens Guild. In September 1960, Mrs. James Rae Arneill, the late Mrs. Edward Honnen, and Mrs. J. Churchill Owen entertained a group of young women at coffee at the Denver Botanic Gardens House. Following this organizational meeting, the Denver Botanic Gardens Junior Committee was formed with its purpose to educate its members in all aspects of gardening and to volunteer its service to Denver Botanic Gardens.

During our second year, perhaps because we saw Mrs. Donald Spencer's illustrated lecture on the growing of herbs; or heard Mrs. Persis M. Owen speaking on the fundamental principles of landscaping and garden design; or shared with Mrs. Hayes Neil the "how's, why's and wherefore's" of growing herbs so that we would be well-educated for our job of saleswomen for the Plant Sale Herb Booth; the Guild made its first major expenditure by purchasing Mrs. Spencer's herbs before her move to Washington, D.C. This was the beginning of Herb Gardening at Denver Botanic Gardens.

Mrs. Gloria Falkenberg has been a member of the Board of Trustees of the Garden for several years. She was a moving force in the development of the Denver Botanic Gardens Guild and in the current fund drive. She has written other articles for *The Green Thumb*.

With boundless enthusiasm and energy, the Guild nurtured these herbs and established the first Herb Booth at the 1963 Plant Sale, digging from their straight-rowed garden 180 plants. At this time, again with enthusiasm and a blessing from the Board of Trustees, and a money-making project "calendars," the Guild commissioned Mrs. Persis McMurtrie Owen to design an Herb Garden — a formal garden as an educational exhibit and a working garden to supply plants for the formal garden and the Plant Sale. The final design was selected in April 1963. The brick paths, laid in five interlocking circles forming the traditional bow-knot design, were completed in 1965.

A charming statue, "The Boy and a Frog," enhanced the center of the dominant circle. This statue was given to Denver Botanic Gardens for the Herb Garden by Louisa Ward Arps in memory of her aunt, Louise Ward Hering, the sculptress. This Garden was formally dedicated to Denver Botanic Gardens in July 1966.

During this time, the Guild continued its wide variety of educational programs and volunteer interests. Changing the name from "Junior Committee" to "Guild", we pointed out that we would not be "Juniors" forever. Our activities included working at the Plant Sale, staffing membership booths, being hostesses at the Terrace and Garden Tours, and later sponsoring the Garden Tours, making garlands of pine greens for the holiday seasons, and planting and

maintaining the Herb Garden. The calendar project was dropped and a new project was undertaken — HERB VINEGAR. Using the herbs from the garden and "an old family recipe, handed down from generation to generation," the Guild made 144 bottles in 1965 — an instant success! The demand was greater than the supply. Each year we have increased our production of both the herb and tarragon vinegars. This year, 1978, the Guild bottled in excess of 3100 pints for the November Christmas Sale.

The Annual Report of 1967 reported that plans were being completed for the undeveloped section of the Herb Garden, actually the working garden. In 1972, the Guild presented a proposal to the Planning and Executive Committees for the extension to the present Herb Garden. The Garden would be more than doubled in size. It would be designed by Jane Silverstein Ries, an outstanding Denver landscape architect. It would include an arbor, a small structure of beauty, a tool and potting area, areas for dye, medicinal, and fragrant herbs. It would have as a special feature a memorial to Mrs. Persis Owen who drew the plans for the original garden which gave proof of her skill as a landscape architect in its fine restraint of design.

With a financial agreement between the Guild and the Executive Committee, both groups passed the resolution unanimously. Plans were approved in the Spring of 1973. By 1974, a drinking fountain was installed, the brick walkways were completed and a red sandstone sundial, a memorial to Mrs. Owen, became a focal point.

Buff concrete benches on the outer curve of the brick walk facing west with others under the arbor were donated by Denver Botanic Gardens in memory of Mrs. Margaret McLister. Mrs. McLister was a staunch and devoted supporter, not only of Denver Botanic Gardens and the Guild but also of the Herb Garden.

In fact, it was Mrs. McLister's great interest that urged the Guild to consider the extension. Also in 1975, an irrigation system was begun.

1976 saw the completion of the irrigation system and the completion of the pergola. The final project, the Gazebo, was completed this spring.

An Herb Garden is a joy and delight filled with flavors and fragrances for the hundreds of visitors to the Botanic Gardens. For the Guild, it is a garden of use and delight, the result of a camaraderie of enthusiastic workers, effort, work, calendars, vinegar, and Garden Tours.

We are grateful for the support, enthusiasm, and outstanding cooperation of the entire staff at the Gardens and the Board of Trustees, and the devoted efforts of all members, past and present, of the Denver Botanic Gardens Guild and their families.

The following thought best summarizes our feelings:

An herb garden created in the imagination and planted by many gardeners' own hands brings some of the purest joys of life; beauty in color and form; bird song and the hum of bees; the music of wind and rain; a pleasure of flavors and fragrances; and the delight in touching silken or velvety leaves.

Friends come to enrich our happiness, bring love, and inspiration.

It was with great pleasure, a shared excitement, a sense of satisfaction and success of a job well done, but with continuing responsibility, that the Denver Botanic Gardens Guild presented to Mr. John Mitchell, President of the Board of Trustees and to Dr. William G. Gambill, Jr., Director of Denver Botanic Gardens, the completion of the Herb Garden Extension — now to be known as the Herb Garden.



Presentation Ceremony Crowd



Herb Garden Pergola

Exotics of COLORADO

Larch *Larix* spp.

Helen Marsh Zeiner

Larches, *Larix* spp., are unique trees because they are deciduous conifers. Conifers are so consistently evergreen that we usually use the terms conifers and evergreens as synonyms, but larches are an exception and lose their needle-leaves every autumn just as broad-leaved deciduous trees do.

All larches have branches which are irregularly whorled and spreading. The bark is thick, furrowed, and scaly. The needle-leaves are fine and delicate. They are spirally arranged on new branchlets, but on older branchlets they are arranged in crowded clusters of many needles on short persistent spurs. They give a feathery appearance to the trees making them desirable ornaments.

A few larches, some quite large, can be seen in Denver. One easily located

European larch, *Larix decidua* Mill., is growing at South High School where it is protected on the south and west by the building. A very large European larch can be seen in Mt. Olivet Cemetery. The eastern larch or tamarack, *Larix laricina* (DuRoi) Koch, is found in Denver even less frequently than the European larch. It can be seen, however, on 17th Avenue and 7th Avenue Parkways.

About 30 years ago a group of larches was thriving in Washington Park, but they have all been removed. At one time the grounds workers thought these trees were dead when the needles fell. They were planning to remove them until they were convinced that these "evergreens" were supposed to lose their needles. What finally caused the removal of this group of trees is not known. It seems probable that some larches in Denver have been cut when the leaves fell because the owner, not knowing this leaf loss was normal, thought the tree was dead.

Dr. Zeiner holds a Ph.D. in botany and taught in the botany department at the University of Denver. She is the honorary curator of the Denver Botanic Gardens herbarium and is a regular contributor to *The Green Thumb*.

European larch was introduced into this country early in the 1800s as an ornamental tree. It is native to north and central Europe where it is a common forest tree. It was introduced into England and Scotland early in the 17th century for use as an ornamental. It became important in estate planting and 14 million larches were planted on 10,000 acres in Perthshire. In 1947, this tree ranked second among the English conifers in spite of heavy cutting during two wars. In its native habitat, European larch is an important forest tree with hard wood used in construction. It is also a source of turpentine, and tannin from the bark is used in tanning leather.

The eastern larch or tamarack is native to the eastern United States and much of Canada. It is often found growing in bogs, but it also grows on well-drained uplands. It has many commercial uses and is a common ornamental tree in the eastern states.

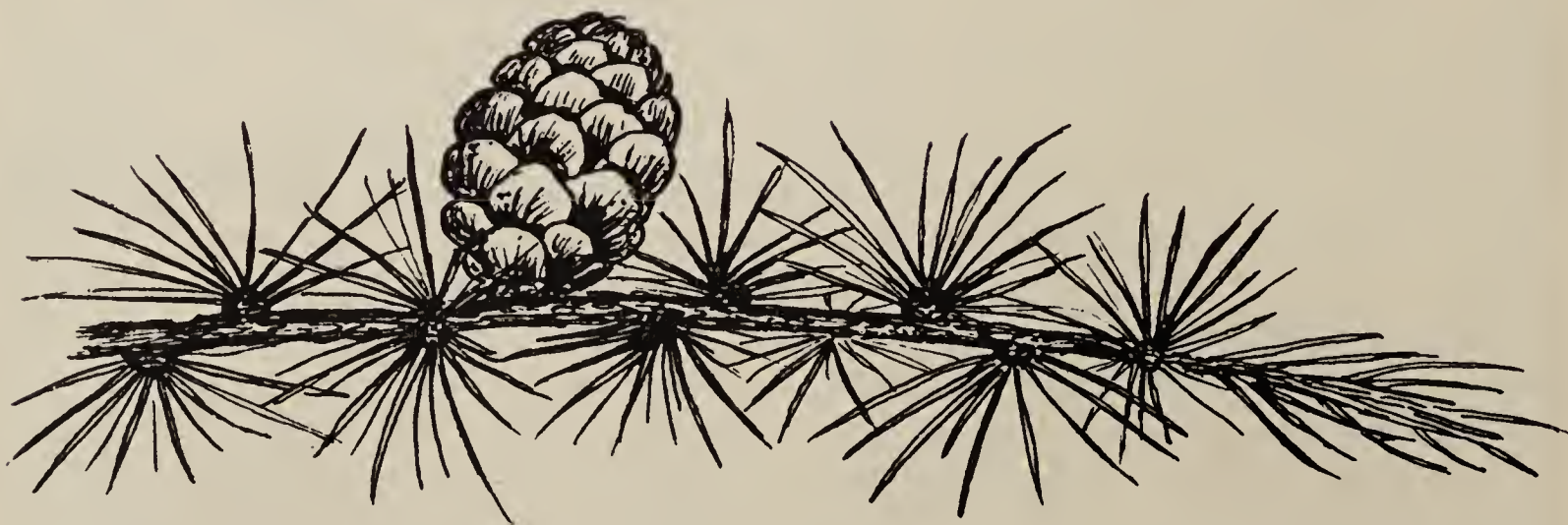
Larches are very similar in general appearance, but there are some distinguishing features. European larch may grow to a height of 100 feet or more.

Eastern larch is a smaller tree often no more than 50 or 60 feet high. European larch has dark grayish-brown bark, eastern larch has reddish-brown bark. Branchlets of European larch are yellowish in color while those of eastern larch are reddish-yellow. The cones of European larch are $\frac{3}{4}$ to $1\frac{1}{2}$ inches long with rounded scales usually covered with very short hairs and loosely appressed at maturity. The cones of eastern larch are smaller, from $\frac{1}{2}$ to $\frac{3}{4}$ inch long, with fewer scales which are chestnut brown and glabrous.

Since both trees can be grown in the Denver area, they are worth considering if you would like something both beautiful and unusual.

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Larix decidua Mill.

Plant Hardiness Map

Bernice E. Petersen

Have you ever tried to fit our gardening area into the plant hardiness zones or length of seasons maps recognized by most horticultural institutions or plant societies in the United States?

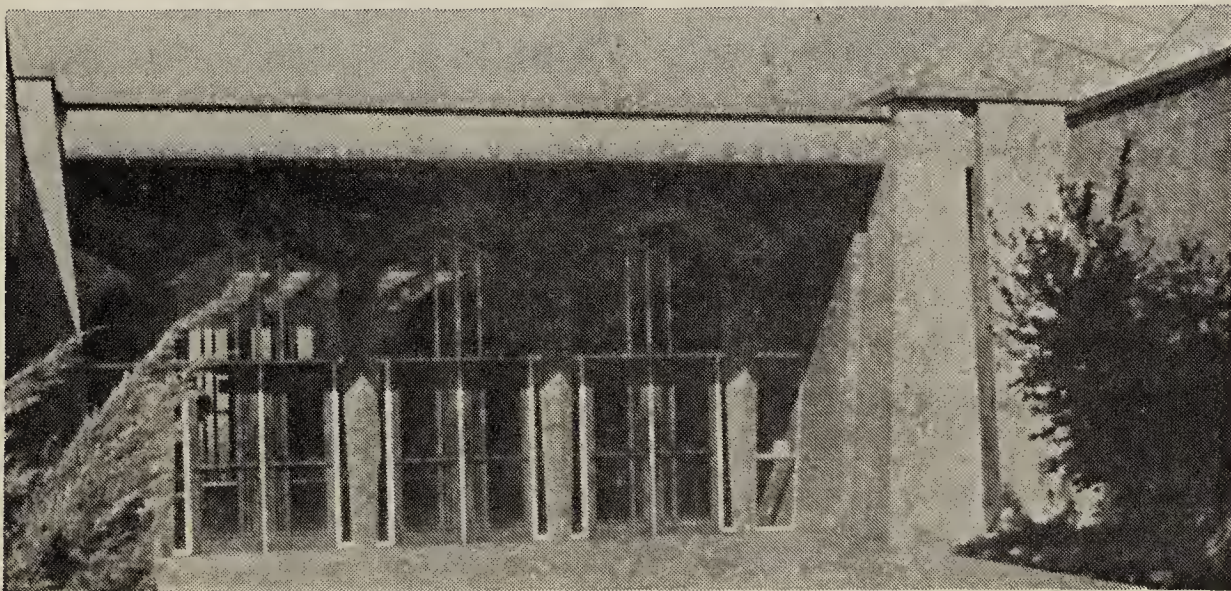
Try as you may you discover that we, unfortunately, don't fit any zone. For more than 30 years George Kelly, well known horticulturist and the author of several books on Colorado plants and trees, has tried to convince national horticultural organizations and gardening experts that "Rocky Mountain horticulture is different" and that Plant Hardiness Zone Maps should include us.

In accordance with Mr. Kelly's suggestions the American Association of Nurserymen published the accompanying map recognizing an "Arid-Alkaline" zone which encompasses about one third of the United States. This reproduction is from its publication *Ground Covers for North America* available at 230 Southern Bldg., Washington, D.C., 20005 at 75¢ each or 40¢ in lots of 25.

Granting us permission to publish the map Mr. Kelly said: "Too long has the Plant Zone Map misinformed people as to what will grow here. Those national horticultural organizations would like to say that we are just a 'small microclimate' when really we include almost one third of the area of the United States, an area of at least 11 million people. Most other areas of the U.S. receive enough precipitation to maintain adequate plant growth but we do not. For many thousands of years this absence of sufficient rainfall has limited natural plant growth and failed to carry away excess alkalinity, creating a generally alkaline soil which many of the acid-loving plants of the east cannot tolerate. Our insufficient rainfall results in low humidity and many hot, sunny days in winter. Also, our proximity to the mountains influences our weather — often unpredictably.

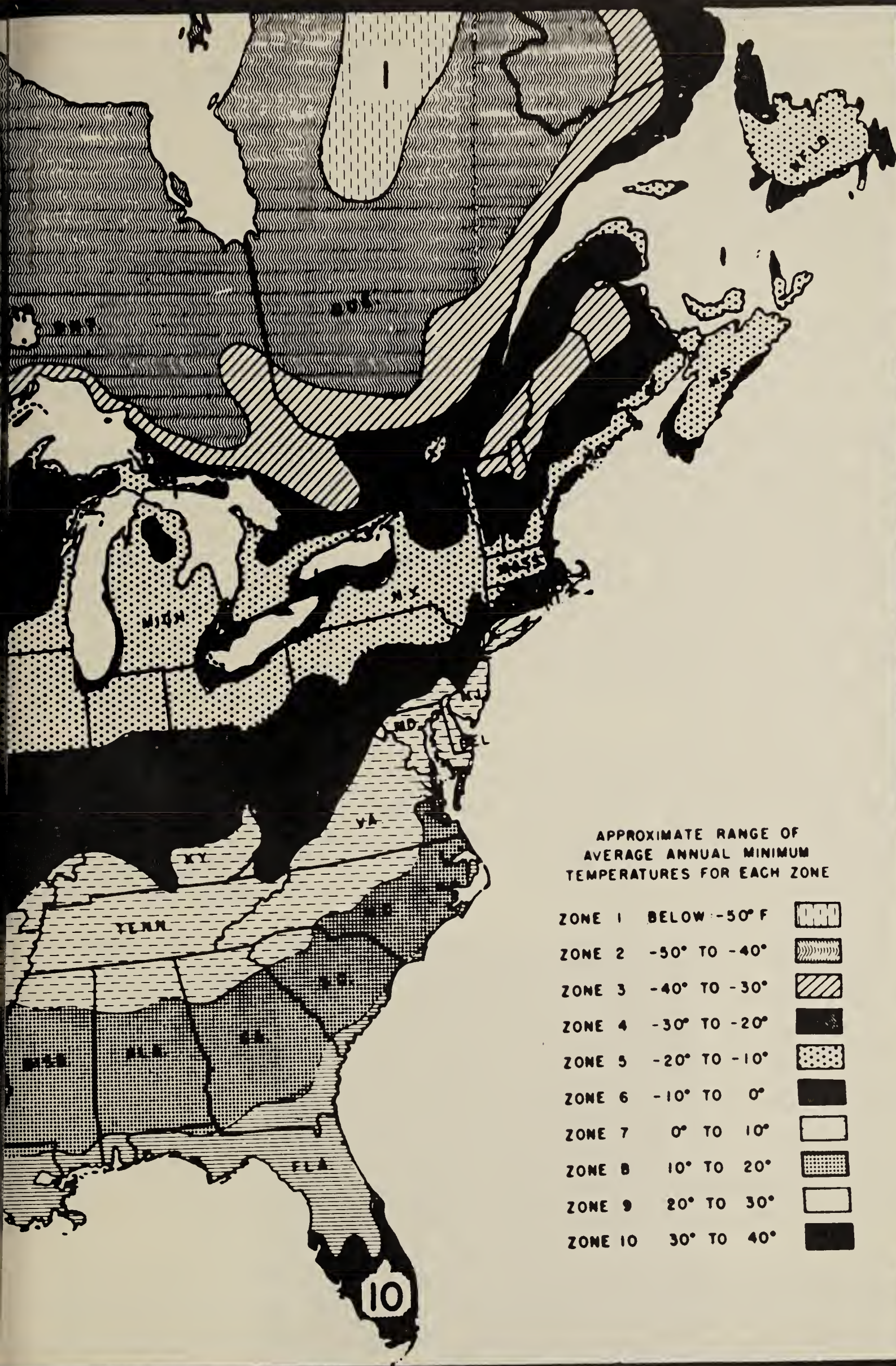
"No longer are we just an area of 'Cowboys and Indians' but a land of modern development and gardens. We should insist on recognition and the elimination of the confusion created by the old zone maps."

Mrs. Bernice Petersen has been associated with *The Green Thumb* almost from its inception. She has been Honorary Editor for many years, has written numerous articles, and has edited a number of issues. She is also a devoted gardener.













Entrance Education Building





APPROXIMATE RANGE OF
AVERAGE ANNUAL MINIMUM
TEMPERATURES FOR EACH ZONE

ZONE 1	BELOW -50° F	
ZONE 2	-50° TO -40°	
ZONE 3	-40° TO -30°	
ZONE 4	-30° TO -20°	
ZONE 5	-20° TO -10°	
ZONE 6	-10° TO 0°	
ZONE 7	0° TO 10°	
ZONE 8	10° TO 20°	
ZONE 9	20° TO 30°	
ZONE 10	30° TO 40°	

Ruth Ashton Nelson

New Beginnings

Marjorie L. Shepherd

When Ruth Ashton Nelson settled in Colorado Springs following Dr. Nelson's death, she shared a house with Kathleen Marriage who was a well known horticulturist and an authority on native plants, alpine plants, and garden design. It was she who had planned the plantings at the old Horticulture House on Bannock Street in Denver. I can remember some quite unusual shrubs and vines growing there. Mrs. Marriage was the founder of Upton Gardens which was a world famous nursery, especially for alpine plants. This was a nice situation for Ruth as they shared the same interests.

By 1955, Ruth was living in her own house next to Mrs. Marriage and in 1963 she purchased a house in Estes Park. Recently she sold the house and bought a comfortable condominium. Now she spends her summers at Skyland Ranch near Estes Park and her winters in town.

In the years following the summer spent in Alaska, when an accident to a color camera had made color photography impossible, Ruth became a very fine photographer of the wild flowers with which she worked. While in Colorado Springs she taught botany classes which were popular. She used her color slides for teaching and for illustrating many delightful lectures. In the summer Ruth spent much time at Skyland Ranch and when the summer seminars were started by the Nature Association at Rocky Mountain Park, she taught there also.

It was during this time that I became acquainted with Ruth. George Kelly and Mrs. Anna Timm (affectionately known as "Timmie") were organizing the trips for Colorado Forestry and Horticulture Association, the predecessor of Denver Botanic Gardens. George was interested in preventing a dam in the Dinosaur country in northwest Colorado and northeast Utah. He organized trips to the area and I joined one of them in the spring of 1952. Ruth Nelson was one of the party. It was an hilarious trip. Washed out roads stopped us from getting to some places that had been planned to see. So, George and his crew of five women spent considerable time and effort mending roads. It was spring and the earth was beautiful. We saw many beautiful flowers — phlox, small paint brush, a bank blue with mertensia, and many others. The birds were numerous and sang sweetly. Always Ruth could tell us which they were.

Mrs. Shepherd's relationship with the Denver Botanic Gardens began in the days of the Colorado Forestry and Horticulture Association when she and Dr. Brunquist were instrumental in the formation of the Botany Club and when she worked with many others toward a Denver Botanic Gardens. She is a volunteer in the Kathryn Kalmbach Herbarium. She has known Ruth Nelson well for more than 25 years.

The last night on the trip we camped at the gateway to Lodore Canyon. Our weather had been lovely up to then but it had turned chilly and rainy. George fixed a tarp for us four females to give us a dry place for our sleeping bags. During the night, Timmie, who was next to me, was moving around and she said she was getting wet and was moving in a little. I got out a flashlight to help her and in the process found that a snake had found a warm place under my bed. (It was not a rattlesnake.) Timmie was up so she removed the snake. George called to us to see what was the matter and we said I had a snake under my bed. He paid us no more attention. Timmie and I showed him the snake in the morning to make him believe us. He said he thought four women would have made enough noise over a snake to be heard for miles and that was why he thought we were joking.

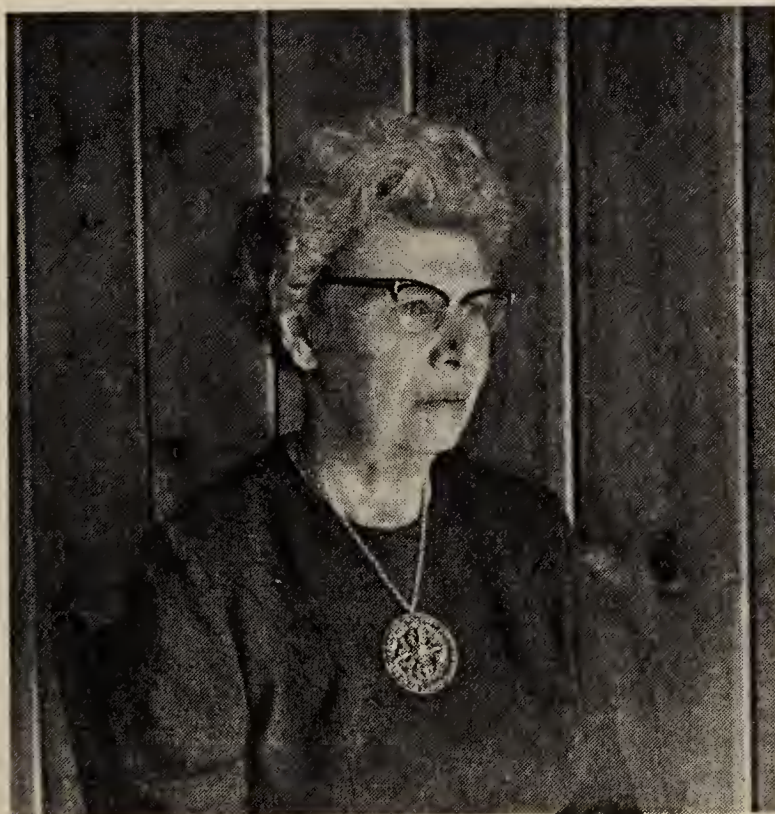
Later on, I had word that Dr. Ethel French, a friend from Rochester days was to come to Denver. She would be with Dr. Babbette Brown, a botany teacher. Both of them taught at the University of Rochester and Babbette had a grant from the University for summer research. She wanted it to be in Routt County. George Kelly and Timmie organized a trip and we spent an enjoyable weekend getting Ethel and Babbette settled into a campsite at Seedhouse Campground. Ruth Nelson joined us; this was a great help as she was as familiar with the area as George. This was the trip when Sue Kelly went fishing and we were treated to a delicious fish fry for dinner.

When Ethel and Babbette returned to Denver from Routt County, we had a trip to Loveland Pass to look at alpines. Ruth joined us and I remember that she pointed out the lovely rose-colored lousewort that grows there as being uncommon. She also entertained my friends at Estes Park for a day.

Having admired from afar, I enjoyed these, my first personal contacts with Ruth, very much. Camping is a real test for all concerned, and Ruth was not found wanting.

Foreign Travel

In July 1954, Ruth attended the International Botanical Congress in Paris. The party made a field trip to the Alps leaving Paris on July 14th. There were only five or six people who spoke English. One of these was Joe Penland from Colorado Springs. After the scheduled trip, Ruth visited the Swiss National Park located on the eastern border of Switzerland.



Ruth Ashton Nelson

It was on this trip that Ruth met Dr. Bettie E. Willard. Bettie, at that time, was teaching high school in California. She was traveling on a fellowship from the Ford Foundation. Ruth and Bettie spent some time together, even sharing accommodations. This was the beginning of a long friendship as Bettie came to Colorado soon after. She started work on advanced degrees at the University of Colorado. The work on her doctorate was in connection with her research on the human impact and damage to the delicate ecology of the land above tree line. Ruth and Bettie shared many of the trails in Rocky Mountain National Park during the years that Bettie was working on Trail Ridge Road.

In the late fifties, Ruth joined a garden tour of England. Then in 1967 and 1968 she made a trip around the world. She wanted to see the spring bulbs in bloom in the Near East and thought she would be able to join the Baggleys who were located there. This was an acquaintance through the park service as they had worked at Yellowstone National Park. She was advised that due to political conditions it was not a good time to visit there. So instead she went to Kifissia, Greece. Here she was welcomed by Nicki Goulandrakis who was involved with a museum and wanted Ruth to spend some time there. She was furnished a room with private bath and breakfast for three months. She did some work with the museum and was able to take some short trips. She came home with many beautiful slides, and I was fortunate in seeing them.

Ruth has had many friends over the years but we cannot pass by Dee Godesiabo. Dee has been a faithful helper with field work. Since Ruth had to take over the second edition of the "Handbook of Rocky Mountain Plants," it is Dee who is helping with the details of distribution of the books. Dee lives near Ruth on what was a piece of Skyland Ranch.

Much Writing Done

Through the years, Ruth has been a writer and has contributed articles to papers and magazines. As early as 1924 she was writing a column for the *Estes Park Trail* entitled "Our Friends Out-of-Doors." After she settled in Colorado Springs, she wrote frequently for our own *Green Thumb*.

The first edition of *Plants of Rocky Mountain National Park* printed in 1933 was exhausted by 1945. Ruth had already started on a revision. The material was sent to the printing office in Washington but for some reason they delayed in producing the new book. Finally, Ruth found that it had gone to press and had difficulty in getting the proof to read. This new book was dated 1953. The book is no longer a government publication but is under the wing of the Rocky Mountain Nature Association who published a third edition in 1970. To visitors to the park from the lowlands, a book to give them some understanding of different plant life zones is a great help. Flowers are one of the outstanding attractions of the park and they vary much as you travel from the entrance to the top of Trail Ridge Road.

Harold D. and Rhoda N. Roberts were among the early photographers working in color to produce a large collection of flower slides. Some of these slides were used for Museum Pictorial No. 8 published by the Denver Museum of Natural History. It was titled *Some Common Colorado Wildflowers*. The Roberts had begun work on a second pictorial but Mr. Roberts passed away in 1956 before the new book was finished. The Museum decided to go ahead with the second pictorial as a memorial to Mr. Roberts. Mrs. Nelson was asked to collaborate with Mrs. Roberts for the botanical material in it.

So, Museum Pictorial No. 13, *Mountain Wild Flowers of Colorado* by Roberts and Nelson was published in 1957.

At this time Ruth had begun to plan a plant book which would cover more territory than the book written for the park. Her friends encouraged her to go ahead with it. After some difficulty in getting it published, a new book called *Handbook of Rocky Mountain Plants* was available in 1969. It covered the mountain region from the Canadian border south to New Mexico. To give you the best picture of Ruth's aim for the book I am quoting from the preface:

"This book is written for outdoor people who are neither botanists nor even natural scientists, but who would like to be able to identify the wildflowers they see on their mountain excursions, and who might, along the way, be encouraged to acquire some interesting, non-technical information about plants in general and the places where plants live. Some of this background information is drawn from historical, ecological, geological, ethnobotanical, economic, and conservation sources. Much of it is based on personal observation and experience.

"For serious students and trained botanists there are many other more valuable volumes. But if those who drive the highways, ride the horse trails, walk the paths, roam the canyons, and climb the heights find herein something to enrich their experiences, this book will have fulfilled its purpose."

The book has keys but each family and each plant has some small distinguishing characteristic called to the attention of the observer. The book is illustrated with black and white photographs and many line drawings. These drawings were done by Dr. Dorothy Vandyke Leake and to me are more useful in identifying than pictures. In addition there is a section of colored plates, twelve in number with six pictures on each plate. Most of these are from Ruth's files. This book filled a long need, as the only book covering more than a limited territory was not useful for a field book and also very technical.

The first edition was soon sold out and everyone was clamoring for a new edition. Ruth was ready with the revision but had so much trouble with the publishing company due to its finances that she arranged to obtain the material from them and have it printed herself. It is listed as being published by Skyland Publishers and was printed by McGills at Estes Park. So the second edition was available in 1977. Another edition? Yes, it is in the making.

On a trip to Zion National Park, Ruth visited the headquarters. There she met Robert C. Foster, former Chief Park Naturalist of Zion National Park and now executive secretary of the Zion Natural History Association. One of Ruth's books was on his desk and he asked her when she was going to do one for them. *Plants of Zion National Park* was published in 1976. The text is by Ruth Nelson and some of the colored pictures were taken by her. The pictures are so well done that one can enjoy the book by just leafing through it. In addition are pencil drawings by Tom Blaue. These are shaded and artistic. The scale of each drawing is noted. The book was put together by a book designer, Robert Jacobson. Ruth told me she thought that had added to the looks of the book. To me, it is a lovely book, pleasant on a coffee table just to enjoy. If you are going to Zion National Park for a visit, it would be a book you must take with you, no matter what the season.

When I visited Ruth recently at Skyland Ranch, we had a nice conversation. She was beginning to prepare for the move back to the condominium in town. Her beloved retriever "Taffy" is no more, and she has adopted an orphan who is charming but not "Taffy." So with a new edition of *Rocky Mountain Plants* in the works, is she finished writing? No, she is thinking about writing a book on plant identification.

Campaign Successful

J. F. Baxter

Early in 1977, the Trustees of the Denver Botanic Gardens approved plans for a Capital Fund Campaign to provide for the expansion and improvement of the Gardens.

It was an ambitious undertaking, budgeted for total capital contributions of \$1,500,000. The plans contemplated an orchid and bromeliad display house; a deep water well for irrigation purposes; the development of an Alpine Garden; funding for the initial improvements and plantings at the Chatfield Arboretum; the completion of an extensive Japanese Garden, authentic in detail; and for a major contribution to the Endowment Fund for the Gardens.

For those active in volunteer work with the Gardens, it is well known that the Campaign was extremely successful and on a very broad base. Generous contributions were made from metropolitan Denver and throughout the State of Colorado and some gifts were received from friends and organizations on a national level. It was heart-warming that over \$1,700,000 was received in cash or in pledges which will enable the Gardens to fulfill the promises and purposes of the Campaign. It would not be possible to identify all major contributors to the Campaign, but the Board of Trustees is especially grateful to the Boettcher Foundation, the Gates Foundation, the El Pomar Foundation, Mr. Ed H. Honnen, the Coors Foundation, and The Associates.

Mr. Baxter is a member of the Board of Trustees of the Denver Botanic Gardens. He is the general chairman of the committee which carried on the successful fund drive in 1977-1978.

One of the chief reasons for reaching the goal and experiencing such a successful campaign was the exceptional volunteer help received from the Steering Committee and in particular from Mr. John Mitchell, President of the Botanic Gardens, and Mr. Richard Kirk, Vice-President of the Botanic Gardens, both of whom served as co-chairmen of the Capital Campaign. These individuals, along with an impressive list of business and professional people, serving as the Steering Committee, deserve credit for making tireless contacts, explaining the plan and purposes of the Botanic Gardens, and seeing to the successful conclusion of the Campaign. Mrs. John F. Falkenberg, a Trustee, deserves special mention for her still continuing hours of volunteer work.

What remains to be done, of course, is the work itself, of building structures, preparing, developing, and completing facilities. Much of the detailed design and architectural work has been accomplished and approved by the Board of Trustees. It is exciting that we are under way with work on the Alpine Garden and the Japanese Garden. The deep water well for irrigation has been drilled and is operational with substantial flows for irrigating purposes. In the course of the next 24 months, most of the plans for which the Denver Botanic Gardens sought capital funding will be realized, and the Gardens expanded and improved for greater public use and enjoyment.

All of us have been proud of the Botanic Gardens to date and the prospects of these new developments add a breathtaking dimension to what the Trustees have visualized and promised in return for financial support.

More *Euonymus* If You Please

Moras L. Shubert

Euonymus species are "valued chiefly for fruit and autumn color, a few for evergreen foliage and a few for interesting habit of growth. — — — This is a serviceable group, easily grown almost everywhere, giving interest and color to the landscape." The above statement, abstracted from Professor Wyman's book quite adequately expresses my feelings about these wonderful plants. But with all their potential, it is curious that they are not used more frequently in our mountain states gardens. It is hoped that readers of *The Green Thumb* will be stimulated to try *Euonymus* species if they haven't already enjoyed the beauty and ease of culture of this group of plants.

A genus of the family *Celastraceae*, these plants were known to Theophrastus and described by him some 2,200 years ago. As you probably know, Theophrastus was one of Aristotle's students who wrote the first books on botany and ecology and is sometimes spoken of as "the Father of botany." What he said about *Euonymus* sounds rather amusing to us for he said essentially this, "These plants are harmful to all things and specifically to goats, which are destroyed by eating the fruits thereof."

Dr. Moras Shubert is the Secretary of the Board of Trustees of the Denver Botanic Gardens and is on the Editorial Committee. He taught botany at the University of Denver. He has written many articles for *The Green Thumb*.

We have not found them to be harmful as long as we do not eat them, and not very many of us have goats in our gardens these days, do we? Although it is apparently true that there is something in the plants which will cause unpleasant symptoms if the leaves or fruits are ingested, no serious cases of poisoning have been reported in this country. Children should be cautioned not to eat the fruits and seeds which otherwise might attract them to taste a few samples.

Doesn't it seem strange that the Greeks would have given this plant a name which literally means "of good name"? I decided to inquire further than the dictionary, which shows only the Greek derivative: *eu* = good and *onymus* = name. It appears that the ancient Greeks associated this genus with a goddess of the underworld known by several names, both good ones and bad ones, but Hecate must have been the one they meant. So rather than to run the risk of offending her, they used a euphemism, much as today we use "so-and-so passed away" to avoid using the word "died."

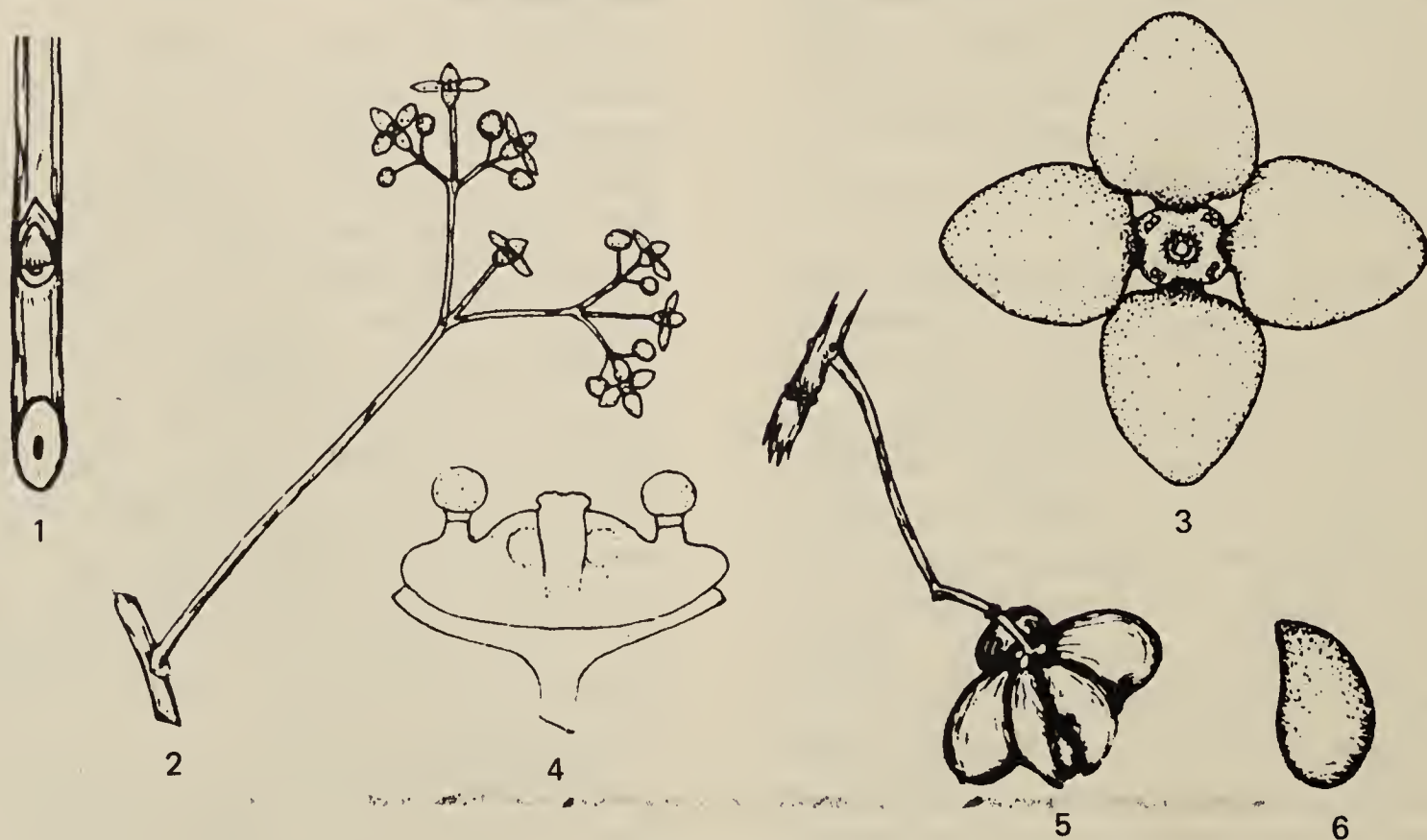
Another item of historical interest is that the people of Europe during the Middle Ages developed a belief that when *Euonymus* flowers and fruit were sparse the year would be productive and there would be little sickness, but when there was an abundant production of flowers and fruit much trouble and ill-

ness would befall the land. Could it be that differences in weather conditions caused not only differences in flower production but also in the healthfulness of the climate? Perhaps wetter seasons not only led to more *Euonymus* fruits but also more bacterial diseases.

Taxonomically, this is a very confusing group of plants. Within a species there may be so much variation of form, particularly during different stages of the life cycle, from juvenile form to maturity that it is almost impossible to give clear-cut descriptions which do not overlap with other species. I have found our old standby, Rehder, to be most useful in keying out the different kinds, even though the descriptions in other references may be more useful to the average gardener. Of the 120 species of this genus now recognized in the botanical literature, Rehder describes 25 "major" species and another 20 "related species." The geographical area where we find the greatest diversity of kinds is from the Himalayas eastward through

China and Japan. We have in our continental United States only four native species, which are: *E. americana* L., *E. atropurpurea* Jacq., *E. occidentalis* Nutt., and *E. obovata* Nutt.

From world-wide sources we now have both hardy evergreen and deciduous species to choose from. Some kinds are especially attractive in the autumn and winter when they display their interesting bi-color fruits. The fruits are characteristically divided into four sections which may be nearly separated or more or less lobed. When the fruit is mature, the outer wall becomes colored some shade of pink, red, or orange, and the wall of each section splits lengthwise to reveal a seed which is frequently covered by a spongy material (the aril) of different color. For example, some fruits have bright pink outer walls with arils of scarlet, while I have seen others of yellow-orange outer walls with very bright orange seed coverings. Although there may be some fading of color, these fruits hang on until spring. Many



- | | |
|------------------------|---|
| 1. Winter twig | 4. Diagram of central portion of flower |
| 2. Inflorescence | 5. Fruit |
| 3. Face view of flower | 6. Seed |

Euonymus atropurpurea Jacq.

species and cultivars, however, are grown only for their beautiful foliage and growth forms, not ever having fruits.

I have observed the performance of several species on the University of Denver campus and in its vicinity for over 30 years. What seems to me to be an outstanding example of the hardiness and ease of care is the hedged form of *E. fortunei vegeta* (Rehd.) Rehd. along a wall on the east side of the Mary Reed building. This half shrub-half vine has had almost no care except watering and trimming and is as luxuriant, if not more so, as when I first saw it in 1946. I do not know how long it had grown there before that time, but I assume it was planted with the original landscape plantings, nearly all of which have died. Another specimen, apparently of *E. europaea* L., grew into a tree form when I first knew it, but because of lack of care it died back to the roots. It is still alive and well in the form of a dense bush. On East Warren Avenue, near South Columbine Street are several shrubs of *E. europaea* L. which have produced beautiful fruits for at least 25 years. These specimens are on the street-side parking and have had very little care and frequently have been very dry, yet passers-by enjoy the beauty of their fruits after the leaves fall. For a ground cover, I can say *E. fortunei minima* (Simon-Luois) Rehd. is dependable and though reputed to be slow growing, it can be used to cover about any size of area by the fact it easily roots and divisions of it can be spread at intervals of about 8 inches apart. It has tiny leaves which are dark green with lighter green along the veins, and on a flat area will lie quite close to the surface. It should be in moderate shade to grow well.

Undoubtedly there are many species and varieties which I have not seen here in Denver, so it would be of interest if readers would report the kinds and locations of species not mentioned. We

would especially like to know this soon, because we are hopeful of starting a collection of *Euonymus* in the Denver Botanic Gardens where visitors can study them. Also, we hope to have trial plantings of less well-known kinds at the Chatfield Arboretum.

It is worth mentioning here that some books dwell on the problems of insect pests, particularly euonymus scale. I have not had any trouble with this or any other pest in all the years I have grown members of this genus. One bush, seen recently in another neighborhood, did have aphids on it, but these insects are so easy to control with a hard stream of water from the hose at frequent intervals, that I do not consider them to be a problem. Washing them off may not get rid of all the aphids, but it gets enough that the predatory insects and birds can clean up the remainder in short time. But the scale insect, which Wyman cautions about, has not been any problem at all even in the dense "hedge" mentioned earlier, on the University of Denver campus.

I can think of no reason why we should not see more plantings of *Euonymus*.

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Euonymus for Colorado

Julia Andrews-Jones

Denver's gardens owe some of their charm and variety to a genus of plants named *Euonymus* (u on' a mas) sometimes spelled *Evonymus*. This genus grows in so many forms that a garden using only varieties of *Euonymus* would have interest of different structure, interesting fruit, varied leaf color, deciduous to almost evergreen.

On an east facing, 7 foot brick wall, *Euonymus fortunei* 'Colorata' Rehd. covers completely. The purple leaved variety is almost evergreen in this protected spot with light shade, the heavy mat opening with some loss of leaves. It and the green leaved form *E. fortunei vegeta* Rehd. climb by rootlets that hold it securely to a vertical surface. Both seem to be susceptible to leaf loss and sunburn damage when exposed to direct winter sun and winter wind. It also mats very well as a ground cover, rooting as it spreads; but it needs some care to keep it from opening up as it matures. *E. fortunei* (Turcz.) Hand.-Mazz. has the same form but I have never seen it and it is not listed in local nursery catalogs.

Euonymus alata Siebold and *E. alata* 'Compacta' are deciduous shrubs with a stout appearing winter character. Both have the distinctive "winged" angles on the branches, their only difference is the size at maturity. They are very well suited to Denver, taking our climate in stride with few demands beyond water.

Mrs. Julia Andrews-Jones has been a member of the Editorial Committee of *The Green Thumb* for many years. She is a local landscape architect. Her article is based on experiences gained from her practice in the Denver area.

ing. They take full sun and are most noticed for their winter character and brilliant crimson-red-orange fall color.

Euonymus atropurpurea Jacq. commonly called Wahoo burning bush is a large deciduous shrub that can be pruned to a tree form and as such makes an outstanding addition to Denver landscapes. We are limited in the variety of small trees (to 20 feet) that do well in this climate. The common name indicates that the light maroon fall color is its most notable landscape asset.

Euonymus europaea intermedia Gaudin has merit also for Denver gardens. The form of its branching makes it more difficult to prune for a small tree shape. It is deciduous and should be used as a large shrub and enjoyed for its handsome fruit and lime-green-colored new wood.

Euonymus hamiltoniana yedoensis (Koehne) Blakelock has many of the same landscape values as *E. atropurpurea* except for paler fruit. The leaves may not be as dark a green but the degree is not notable. I have not had the opportunity to see if its performance in our climate under stress would give one a higher landscape value than the other.

Euonymus glabra Roxb. is another one with a small tree structure. Its fall color is not as bright as *E. atropurpurea* nor the fruit as highly colored but it is hardy and has merit.

Euonymus comes in a partly evergreen medium high shrub form, *E. kiautschovica* Loes., listed in nursery catalogs as *E. patens*. It is much used in Denver plantings on north facades or in diminished light conditions. Under stress it is

deciduous; the amount of stress determines the degree of evergreen it will be. An evergreen with light green leaves has high landscape value. Its texture and scale are different from any other plant with the same cultural requirements. It needs some care to keep its shrub form as it tends to grow wide and sprawl. It will open up with part becoming creeperlike without any rootlets to support it.

Euonymus fortunei 'Pyramidalis' is an upright growing form of an earlier mentioned vine, but I list it here because I would group its landscape value as a medium to smaller shrub.



Euonymus fortunei vegeta Rehd.



Euonymus europaea L.

Other cultivars of it are *E. fortunei* 'Sarcoxi' and *E. fortunei* 'Robusta'. The leaves are light green, appearing delicate and lush. Whether it is more evergreen or deciduous depends on the stress it undergoes during our arid winters with their burning sun. *E. f.* 'Robusta' is the form with larger leaves. *E. f.* 'Minima' is a small form with very small leaves. It is so compact that I use it in underplantings as a ground cover.

One of our great accent plants because of its ground creeping form, its small scale, and its handsome variegated cream and green leaves is *E. fortunei* 'Variegata' and the smaller *E. f. acuta* Hart. In protected situations where it is well watered it is evergreen. This species has a distinctive place in our available plant material.

So you see how the variety and interest in our Denver landscapes may be so enhanced by that genus *Euonymus*.

Plants on The Move

Janet C. Wingate

The evolution of fruits and seeds has been a major factor in the success of flowering plants over other kinds of plants. The seed is a fascinating structure, composed of an immature plant and its food supply both enclosed in the fruit. The seeds may separate from the fruit as in milkweed or remain within the fruit as in a cherry. An important characteristic of the seed is that it can remain dormant until proper conditions for germination occur. During this time the seeds may be dispersed by wind, water, or animals to new and perhaps more desirable locations.

Some seeds are very small and light and can be blown by the wind. For example, members of the orchid family produce dust-like seeds, so small that a single fruit may produce a million seeds.

Other plants produce fruits or seeds with plumes, or tufts of hairs, which carry the fruits or seeds aloft. The hairs may be outgrowths of the seed coat, as in fireweed and milkweed. Members of the composite family, such as asters, dandelions, thistles, and sunflower, develop "parachutes" from the floral part called the pappus or sepals.

Many fruits develop wings. Maple, elm, ash, and tree of heaven are good examples. Some seeds also develop wings, such as those of the wildflower butter and eggs.

Dr. Janet Wingate is on the Editorial Committee of *The Green Thumb*. She and her husband edited the magazine for several issues. Her degree is in Botany and she teaches at Metropolitan State and the University of Denver. She checks the scientific accuracy of many articles appearing in the magazine.

Sometimes the entire plant breaks off and disperses its seeds as it rolls along the ground. These are the tumbleweeds and include Jim Hill mustard, pigweed, and Russian thistle.



Winged Fruits

Some plants discharge their seeds or fruits with significant force. Mistletoe shoots its sticky fruits to nearby branches. In touch-me-nots, compartments of the fruits open suddenly and eject the seeds. In witch hazel, a portion of the fruit wall contracts and discharges the seeds sometimes as far as 15 meters. In the poppy, there are holes around the top of the fruit and the seeds are shaken

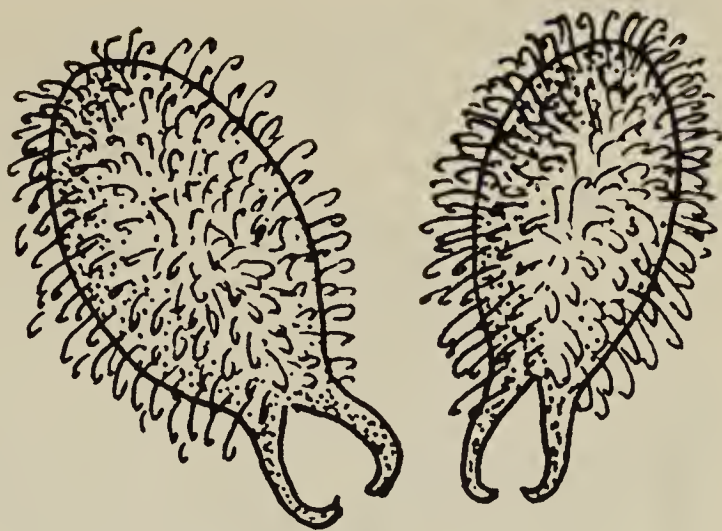
from the capsule like salt and pepper.

The fruits and seeds of many plants that live near water have modifications for flotation. This is due to air trapped in or around the fruit, or to buoyant tissue. The fruits of sedges are encased in a sac called a perigynium which is often inflated. The fruit of the coconut tree floats and has been readily dispersed to many tropical islands by the ocean. Rain is a common means of dispersal of plants on slopes and hillsides. Seeds and fruits that fall in mud near streams, ponds, or lakes may be picked up by the feet of water fowl or other animals and transported to new areas. Charles Darwin found 536 seeds in 6¾ ounces of mud taken from the feet of birds.

Man has played a large role in dispersing seeds great distances. The Jim Hill mustard, named for an early railroad magnate, was believed to be spread across the United States by the railroads. Most of our common weeds, such



Devil's Claw Fruits and Seeds



Cocklebur Fruits

as dandelions and kochia, were transported from Europe by man.

Fleshy and often highly colored fruits, such as cherries, strawberries, grapes, and raspberries, are commonly eaten and dispersed by animals. The seeds pass through the digestive tracts of the animals unharmed. Dry fruits such as nuts and grains are also collected by animals for food. Some are eaten and others remain to germinate in their new location.

Many fruits have hooks, bristles, or spines which adhere to the fur of animals or to the clothing of man. Beggartick, cocklebur, burdock, sandbur, and buffalo bur are common examples. The devil's claw has two large hooks that readily attach to animals.

Through these and other modifications of fruits and seeds, flowering plants have been able to migrate into new areas and thus enhance the possibilities of survival of their species.

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Focus on

Persea americana

in the

Boettcher Memorial Conservatory

Peg Hayward

The avocado, native of Mexico and Central America, was being used extensively by the Aztecs and other Indians when the Spaniards arrived in the New World. Aztec picture writings had a sign for the avocado. The early Spanish spelling of the Aztec name was *abuacatl*. The English name, avocado, is derived from Spanish modifications of the original Aztec word. The tree was introduced in the West Indies soon after the arrival of the Spaniards. Since then it has made its way around the Equator. However, the avocado did not achieve popularity until the twentieth century when horticulturalists in Florida, California, and South Africa began planting orchards and exporting fruit of high quality.

Mrs. Hayward has been active in Denver Botanic Gardens for many years. She has been a leader in the preparation of *The Conservatory Guide* and in the training of guides. Her article "Focus on" has been a feature of many issues of *The Green Thumb*.

Of the 50 species of *Persea* by far the most familiar is *Persea americana* Mill., member of the laurel family, Lauraceae. The avocado, sometimes termed alligator pear, is a small or medium-sized tree with a dense top. Although the tree is evergreen it tends to behave as though it were deciduous, and it is not unusual for it to lose all its leaves from the previous season's growth at the beginning of a fresh flush of growth. Growth tends to be from the ends of branches rather than from sprouting buds or older wood. This results in spreading trees, with branches that are often bent down under their own weight.

Large coarse lance-ovate leaves, often a foot or more in length, are slightly aromatic when crushed. Each tree produces dense clusters of inconspicuous, small, greenish flowers. As many as 1,000 flowers may appear on a branch no more than a foot long and yet only one fruit may set per 5,000



Persea americana Mill.

flowers. Fruit of the avocado is variable. It may be small or grow to as much as 12 inches in length and 4 inches in diameter; color is dark green to dark purple; it may be smooth or rough skinned, nearly round or more often pear-shaped, sometimes with an elongated neck.

A cavity inside the fruit contains a large, brown, egg-shaped seed, which may be as thick as the flesh around it. When ripe, a good avocado has a thick layer of greenish or yellowish flesh of a buttery consistency. In food value the avocado is different from most fruits, having a very large percentage of oil, as much as 20 per cent. The fruit is said to be highly nutritious, containing almost twice the energy value of the banana, very rich in protein, calcium, iron, phosphorus, and vitamins but low in carbohydrates. No wonder that the avocado has assumed much importance in the tropics.

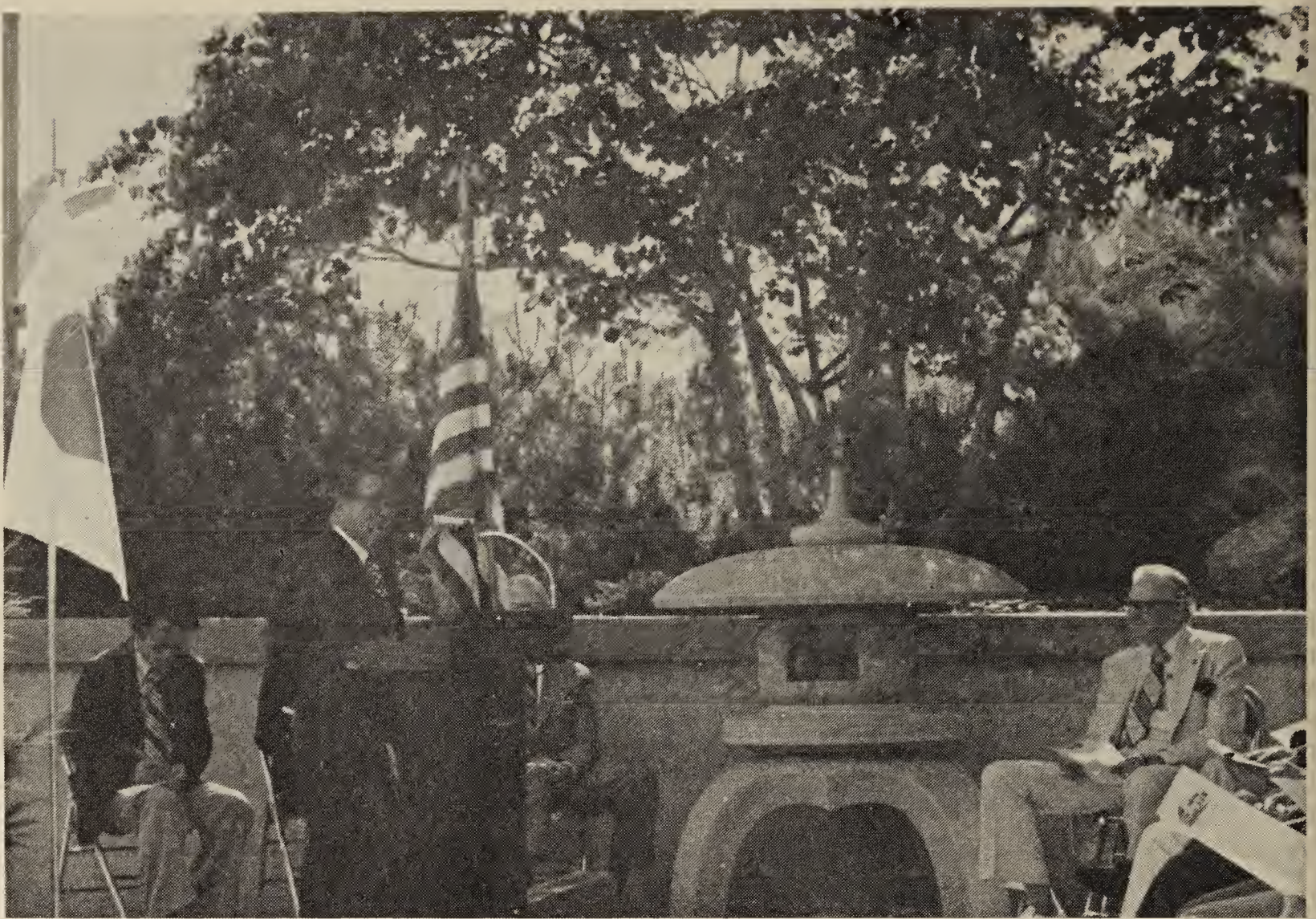
Three forms of avocado are generally recognized: Mexican, which is the hardiest. The fruit is small, thin skinned, and the flavor considered the choicest. Guatemalan has a rough or warty fruit,

thick woody skin and can be up to 2 pounds in weight. West Indian is the least hardy of the three forms. The fruit is large with leathery skin, and the flavor is excellent.

Avocados are a profitable crop as the trees begin to bear when 4 or 5 years old. Many continue to bear for 50 years and may produce as many as 500 fruits annually. Uses are spreading rapidly not only for salads and desserts but for therapeutic purposes. The seeds yield a reddish-brown dye for marking clothing. The fragrant flowers are attractive to bees, making this tree a honey plant.

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Presenting the Lantern



The New Gazebo

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Iris sp.

Jack Riley

Born Jan. 22, 1905; died May 7, 1978.

Jack grew all kinds of irises, the species *Iris Balkana* Darby, *I. barthii* Prodan, *I. pumila* Hanselmeyer, *I. Montana* Goodd, and *I. missouriensis* Nutt. are a few that come readily to mind. He also grew many different cultivars of spurias, siberians, and tall bearded irises, but the median irises were his favorites.

Harry B. Kuesel

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The Green Thumb

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SPRING 1979



THE COVER

Spring is Here.

THE GREEN THUMB

SPRING 1979

VOL. THIRTY SIX, NUMBER ONE

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For further information write to Membership Chairman, Botanic Gardens House, 909 York Street, Denver, Colorado 80206, or call 575-2547.

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William H. Anderson, Jr. Ed.D.

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Editors

SPRING 1979

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Vegetables For Denver Gardens

John A. Brett

Vegetable gardening is traditionally an activity available only to those with land. The increasing numbers of high rise dwellers in Denver contain among their ranks many would be gardeners who lack access to land.

One solution to this is community gardening, a growing phenomenon around this country but one which has been practiced in Europe, where land is at a premium, for centuries. The Denver Botanic Gardens presently sponsors a community garden program on two sites, 11th and York Street and 2950 Jackson Street. The program is organized around a family concept with each family unit having a plot. Much emphasis is placed on the teaching of the best gardening techniques for Denver conditions.

As a part of their plot rental fee the gardeners are supplied with a good basic selection of seeds and bedding plants to choose from. All of the varieties used are proven performers, selected on the basis of past experience and as a result of testing done in our trial garden. Many of the varieties used are tried and true standbys. In addition, test varieties that prove themselves superior to those currently in use will often be included in the following year's selection.

In selecting a variety for the program the following are looked for: vigor (strength of growth), disease and insect resistance, number of days to maturity, productivity, length of peak production, flavor and keeping quality. If a vegetable is particularly weak in one or more of these areas it probably won't be used unless it has compensating strengths. Cucumbers are a good example; many of the varieties used are susceptible to various fungus diseases late in the season but produce well through the middle of the season, making them quite acceptable.

The following discussion concerns several vegetable varieties that warrant mention due to high quality in one or more areas.

Of the many different pole beans tried over the last several years we've still not found one that out-performs Kentucky Wonder. In our experience the only complaint of note is that they get tough and stringy if left on the vine too long. On the plus side it has strong growth, produces early and consistently, and has a flavor some consider the base to which all other beans are compared.

John A. Brett has been the gardener in charge of the Denver Botanic Gardens community gardens project for several years. This experience enables him to write this valuable article specifically for Denver gardeners.

Most gardeners prefer bush beans because of their earlier production and easier culture. Two warrant mention: Improved Commodore and Royalty. Improved Commodore is a bush-type Kentucky Wonder with a unique flavor. Like most bush beans it produces very heavily over a short period and then must be replaced. In a good year two plantings may be fully harvested, and a third will begin bearing before frost. We found Royalty to be delightful; it's purple! The stems, leaf veins and beans have a rich purple color to them, making them extremely attractive, especially when interplanted with green varieties. It also produces heavily over a short period but unlike many it continues to produce smaller harvest over an extended time. Upon cooking it turns green-bean green and expresses itself with a novel flavor equal to its beauty.

Carrots are a difficult vegetable to grow in our gardens. Because of heavy clay soils, seeds don't germinate well and the carrots often don't look like carrots. Two approaches have been used to deal with the problem: the addition of large amounts of organic matter to the area in which the carrots are to be grown and the use of short carrots. Organic matter loosens the clay considerably, thus preventing crusting and promoting better root development.

Danvers Half Long, listed in catalogs as reaching 7-7½ inches, usually succeeds in growing to a length of 6 inches in our soil. We've found this carrot germinates better than many in our crusty soil, is a strong grower, and produces a stocky carrot of fine flavor. Baby Fingers Nantes was tried this past year in the trial garden and received rave reviews from all who passed it between their teeth. At maturity it stretches a mere 4 inches against the ruler and is "the sweetest, tenderest carrot I've ever eaten!" It may well become a regular in our gardens.

Ah, sweet corn, the vegetable about which the most frequently asked question is, "when will it be ready?" Ask any gardener what his favorite sweet corn is and chances are, you'll get a different answer from each one.

Early Sunglow, the most commonly planted variety, has been well received in the program because of its earliness (60 days) and high quality. Two 8 inch ears, often 3, per plant that are well filled and moderately sweet make this a good basic variety around which other types may be tried. A trial-garden variety that got high marks this year is Gold Winner (79 days). Germination and growth were uniform and strong, a consideration well worth taking into account because our heavy clay soil often seems



Community Garden at 2950 Jackson Street

never to warm in the spring. Ears were 8-10 inches long, crowded with small super-sweet kernels. A point well worth mentioning in favor of this corn is its ability to "hold"; that is to say it's not going to be at perfection for a day, then get tough and starchy as is the habit with many sweet corn varieties. Harvesting may take place over several days and still provide acceptable quality ears.

Garden surveys indicate that nationwide, tomatoes are the most popular home garden vegetable. The gardeners in the community garden program are no exception, several of whom signed up only to have fresh tomatoes. Of the dozens of varieties grown, only a few were of a quality to justify mentioning. Tomatoes have been an unlucky crop with us for a variety of reasons, including a mysterious disease that killed almost the entire crop one year and major insect infestations.

Fantastic has, to date, been the most consistent of the varieties grown. As a determinate plant it tends towards bushiness and never gets very tall, thus making it a low maintenance plant. Production is heavy, steady, and relatively early (70 days). Flavor is good but not spectacular. Burpee's Better Boy has been the star of the show in several gardens; usually it is the last tomato to ripen but well worth the wait. Fruits are large, scarlet red, and about as juicy as a tomato can be. Vines are large and produce heavily, often with as many as four or five fruits ripening on the same day.

Spring gardening brings to mind peas fresh from the garden, sweet and succulent. The current rage among pea lovers is the edible pod varieties or snow pea. They've been around for centuries and are well represented in oriental cuisine but are just now becoming popular in this country. Oregon Sugar Pod has met with the greatest success of the several tried. It's probably not the sweetest available but seems to do better than other varieties when the weather turns hot, thereby making it more suitable for our program which starts after the ideal planting date for peas. The flavor is grand, on a par with most and better than many.

Snow peas are harvested when the pea just starts to develop inside the pod. The entire pod is then briefly steamed or stir fried or added at the last moment to soups or stews for a sweet, crunchy treat. By planting the edible pod varieties you get more edible vegetable matter per amount of garden space, making these types valuable for small or intensively managed plots.

Zucchini, the vegetable that is both the bane and blessing of the vegetable gardener, will grow where almost no other plant will. It has relatively few pests in our area and will accept a certain amount of neglect. Given a modicum of care, though, it will produce until most gardeners are driven to distraction trying to figure out what to do with all of the zucchini crowding the swiss chard in the garden and the milk carton in the refrigerator. One gardener swore that an 8 inch "zuc" grew while he was picking his beans one afternoon!

Burpee's Golden Zucchini and Clarita are the two most popular in the community garden program. Burpee's Golden Zucchini is in all respects like an ordinary green zucchini except that it has a beautiful golden yellow skin and is slightly stronger in flavor. Clarita has become the most coveted of squash in the garden. People who had tasted it but not planted any would be seen wandering around the garden looking for stray Clarita that they could take home for their very own. It has the basic zucchini shape but is rounder and pale green in color.

The flavor of this squash is behind its spectacular success as a garden vegetable, with hints of cucumber and avocado drifting about within its skin. The best use for this squash is to pick young (6 inches), slice raw in salads or use for dipping with other vegetables in your favorite dip.

PROBLEMS FACED IN THE COMMUNITY GARDEN PROGRAM

PLANTING

Planting problems usually center on quantity and timing. It's hard to envision that a handful of lettuce seed will produce more lettuce in 5 weeks than most families eat in an entire year. One wouldn't expect six zucchini seeds planted in two hills to overwhelm the merry gardener with their cylindrical treasures. Other vegetables overplanted are beets ("what am I gonna do with all of these beets, I don't even like beets?!"), radishes, and parsley.

Timing is a factor often overlooked. Corn and bean seeds sit shivering in the soil waiting for the spring warm-up while late planted peas pop up and get sunburned.

WATERING

Surprisingly, many gardeners get too much water on their gardens rather than the expected too little. We stress conserving soil moisture by conditioning the soil and by the use of mulches. With a good mulch in place watering should have to be done once a week or less. Some mulches that we've found to be practical are straw, grass clippings, grass clippings mixed with sawdust, and woodchips for the paths.

Watering being an activity that people seem to enjoy, they tend to do it every time they come to the garden, two to three times per week, resulting in a soil that remains saturated. This decreases the amount of oxygen in the soil causing roots to rot and plants to die. Not watering thoroughly is another situation to be confronted. By watering shallowly at frequent intervals one forces the roots to grow near the surface of the soil. If for one reason or another the plot doesn't get watered for an extended period of time the plants suffer immensely. The better route to go is to water infrequently but deeply so that the plant roots are encouraged to grow down in search of water as the top dries. With a deep root system the plants are better able to withstand the midsummer bouts with drought.

CULTIVATION

There is a continuing debate on the subject of cultivation. One group is of the opinion that regular cultivation is the best thing that can be done for a garden. The opposing group states that the less cultivation one does the better for the plants — mulching is the way to go.

The cultivators offer these arguments: Cultivation opens up the soil and breaks up the crust that forms on our clay soil. By the breaking up of the top inch or so of soil, oxygen is mixed in, water penetration is increased and weed growth is inhibited. As water percolates through the soil it pulls oxygen down with it, benefiting the roots. Regular cultivation creates on top of the soil a dust mulch, a layer of very fine dust that prevents evaporation. Anyone who has walked through a dryland wheat field knows of this phenomenon.

Those who do not cultivate have this to say: Cultivating opens up the soil, increasing evaporation. By disturbing the soil surface weed seeds are brought up, allowing germination, also root damage to plants is increased. As the solution they offer mulching. Mulch added to the top of the garden prevents rapid drying of the soil surface, greatly reducing crusting. As the mulch decomposes it adds valuable humus to the top inch or two of soil, thus loosening and opening up the soil and further preventing crusting as well as increasing water and oxygen penetration.



A Happy Vegetable Family

FERTILIZING

Fertilizing is accomplished in several ways within the program. The first project gardeners must confront in the spring is the spading of their gardens. At this juncture liberal amounts of compost are incorporated into the soil. This supplies some nutrients but more importantly by loosening up the soil much of the mineral content chemically bonded to the clay particles is freed for plant use. After the plot is well raked a starter fertilizer is applied and worked into the top 2 or 3 inches of soil. This is a low nitrogen, high phosphorus fertilizer that promotes strong initial root growth in the seedlings, important in strong plant growth. Later in the season, depending on the plant, side dressing is done, a process giving the plant an extra boost when it is producing most heavily. Side dressing is accomplished by opening a shallow furrow next to the row or around the plant (beyond the root zone), adding the chosen fertilizer — compost, manure tea, or a low dose inorganic fertilizer — then closing the furrow and watering well.

INSECTS AND DISEASE

Insect and disease control are probably the most difficult problems that any gardener is going to have to face and those in the program are not exempt. The only disease that has caused extensive damage here was a tomato virus in 1977 that destroyed nearly everyone's tomato crop. Good cultural practices and the use of resistant varieties are the best defenses against disease.

Insects, though, are in many instances an extreme problem for gardeners. The situation that is presenting the most difficulty in solving is that if one or more garden plots are neglected and allowed to become weed and insect infested it becomes increasingly difficult for the remaining gardeners to keep insects under control in their own gardens.

An integrated approach is being used toward insect control. To the greatest extent possible organic methods are used, chemical means being used as a last resort in the event of severe infestations.

The imported cabbage worm, aphids, and white flies present the greatest danger to crops in our gardens. Good control of the cabbage worm has been achieved using a product containing the bacterium, *Bacillus thuringiensis*, a disease-causing organism to several insect larva harmful to fruit and vegetable crops. The bacterium paralyzes the digestive tract and causes the worms to stop feeding within several hours after ingestion; death occurs in 2 or 3 days. Application is done once a week from the time the small white cabbage butterfly appears. It is safe to use up to the day of harvest as it is non-harmful to humans, pets, or beneficial insects.

Aphids and white flies present a much more difficult situation for control. Again in many cases non-pesticide control measures are attempted before resorting to chemical means. If the plants are small, aphids and white flies may be hosed off which is often sufficient. If when the plants are older and cultural methods have failed to solve the problem, so-called organic pesticides are employed. These were originally derived from tropical plants and are much less toxic than other common pesticides, but used diligently and frequently can control insect populations. Occasionally this is insufficient, because of the time and effort required for success. We must then rely on more potent synthetic pesticides, malathion being the most commonly used. Our aim in any control measure is not in any way an attempt to eliminate the pest but to keep the populations at a level so as to prevent severe plant damage.



Botanic Gardens Test Plots

Arboretum Planning

Newell M. Grant

Much has happened since *The Green Thumb* Winter 1976 carried an article on the Chatfield Arboretum. We have all been surprised at the vigorous economic growth of the Denver area over the last several years, and this growth has been most apparent near the Arboretum site. While no housing developments actually adjoin the Arboretum it seems that the availability of domestic water taps is the only reason, for we understand that the land to the south, overlooking the Arboretum, is in the hands of a developer. The Chatfield Recreation area, which surrounds the Reservoir, is run by the Colorado State Board of Outdoor Recreation and is already handling increasing numbers of visitors in the summer. The Ken-Caryl Ranch development of Johns-Manville Corporation is proceeding, and in fact is stimulating residential and commercial growth in that sector of the metropolitan area; in the years since the last *Green Thumb* article, several hundred housing units have been built on the Ken-Caryl Ranch alone!

All these neighborhood and economic changes have been matched by progress on the Arboretum itself. We on the Arboretum Committee are very excited by the Arboretum and the plan for its development. Its contribution of making known additional plant materials with reduced water usage requirements in an era of increased water conservation will help residents and businesses with landscaping problems. As we go along, however, the progress we have made seems minute as we realize how large a project development of the Arboretum actually is; we press forward because we see it a little closer and are captivated by its very exciting potential. What a magnificent pearl it will be!

What Have We Done?

Very little of our progress is visible on the Arboretum site itself, but the foundation is being set for a very exciting development. Some of the major accomplishments of the last couple of years are as follows:

- preparation of a Chatfield Arboretum Master Plan and Master Plan Report
- redevelopment of an irrigation well and a domestic well on the Arboretum
- preparation of a Master Plan for water distribution and irrigation
- movement of the school house from its old location near South Carr Street to a site next to the parking lot, with the intention of remodeling it to serve as a Visitors' Center

Mr. Newell M. Grant is the Chairman of The Chatfield Committee of the Board of Trustees of the Denver Botanic Gardens. He has written about the beginnings of The Chatfield Arboretum in an earlier issue of *The Green Thumb* and in the *Annual Report* for 1976.

- two applications have been submitted for grants for matching funds from the Land and Water Conservation Fund
- a thistle control program, through the Colorado State Forestry Service, has been undertaken each year
- repairs were made on the silo to prevent its destruction by vandals
- a report was prepared by the Jefferson County Historical Society on the Hildebrand Farm
- printing and distribution of a flyer describing the Arboretum

Many of these items need no further explanation, but the Master Plan is the important step everyone is interested in!



Chatfield Master Plan

The Chatfield Arboretum Master Plan

After a selection process involving a number of firms, the Committee recommended to the Board of Trustees that the Denver firm of Harman, O'Donnell & Henninger (referred to as "HOH") be engaged to prepare a Master Plan. The Trustees concurred, and HOH began work in April 1977. The Master Plan was presented to the Trustees on January 24, 1978.

Preparation of the Master Plan was an exciting learning process for all of us. We — or at least I — came to have a much clearer view of the Arboretum site and the planning process by watching David Jensen, Brad Nelson, Mike Pharo, and Diana Webb of HOH in action. They carefully and thoroughly assembled background material from a variety of sources, distilled it through almost a year's meetings with members of the Gardens staff and the Committee, and a concept of development evolved into the Master Plan.

We feel that the Master Plan is a very sound and carefully thought out basis — an eminently practical one, at that — for the development of the Arboretum. If a planner's task can be arbitrarily defined as anticipating change and its effects, the HOH Master Plan would certainly seem to be successful. After the Master Plan was completed, HOH prepared a Master Plan Report which summarized the background of the Arboretum and reviewed the physical characteristics of the site including soils, slopes, vegetation and wildlife, wind and air currents, cultural features, and visual elements. Other arboreta around the country were queried by questionnaire as to what facilities they had and used or didn't use, what they wished they did have, and what their objectives were. Since there is no clear or generally accepted purpose for an arboretum's existence, responses and facilities varied widely.

To quote from the Master Plan Report:

The Master Plan represents a framework for development of the arboretum to best meet the educational research, historic stewardship, and administrative and maintenance functions. Some elements of the plan were dictated by pre-existing constraints . . . It was also the request of the Denver Botanic Gardens to keep away from highly formalized landscape design, to keep maintenance and irrigation needs to a minimum, and to maintain a 'natural' feel to the design while meeting the purposes of the arboretum.

The Chatfield Arboretum will primarily be planted with woody species, but also will have open space for contrast . . . Display plantings of trees, shrubs, and liana (woody vines) will represent both native species and tested exotics. Experimental plantings will be integrated to test the suitability of introduced species of less certain performance under local conditions. Because of the adverse nature of the pre-existing environment of the arboretum site for many species, windbreaks will be planted to provide protection for the establishment of less hardy plants.



Hildebrand House

The overall Master Plan concept is that private vehicular traffic will be limited, with a circulation pattern through the Arboretum. The administrative and maintenance operations will be centered in the Green Farm buildings. No portion of the Arboretum has been planned in detail; only the general location or concept of development has been indicated. The Master Plan for the Botanic Gardens at York Street was developed by EDAW in the same fashion; other planners and landscape architects have done a number of designs for specific gardens and areas over the years, all within the original Master Plan. And it will be the same at the Arboretum.

Implementation of the Master Plan

The Chatfield Arboretum is being developed on land which is held under a 25-year lease from the U.S. Army Corps of Engineers through the City and County of Denver. This lease, which expires in the year 2000, provides a framework for development in five phases of five years each. The Master Plan Report schedules the development in those phases.

The first phase (1975-1979) calls for a planting program for the entry drive, Visitors' Center, and establishment of a nursery. The only facility will be remodeling of the schoolhouse as a Visitors' Interpretive Center. As we enter the last year of this phase, the nursery has been established (though not satisfactorily), the master planning completed, a number of large trees acquired for the entry drive, and the schoolhouse set for renovation.

Phase II (1980-1984) calls for development of 60 acres, most of which is to be screen plantings and windbreaks. Experimental, specialty, and synoptic gardens will be begun, and the irrigation system will be expanded. The Green Farm remodeling will also get underway, as will the Hildebrand Farm restoration; in addition greenhouses will be constructed. It is estimated that the number of annual visitors to the Arboretum will average 1,500.

Phase III (1985-1989) will see the pathway system developed and greenhouse space enlarged. Groves of trees and the meadows will be planted, screen plantings and experimental materials planted; a total of 120 acres will be planted. With previous plantings in the earlier phases, a total of 190 acres should be under development.

Phase IV (1990-1994) anticipates 100,000 visitors per year and the parking lot, pathway system, and maintenance facilities will require expansion. About 100 acres of plantings will be undertaken, most of which will be expansion of existing areas or display gardens and groves.

Phase V (1995-1999) will see about 250,000 visitors per year. An auditorium or increased office and laboratory space may be added, and the planting programs will be continued. During any of the last phases a public tram system may be added.

Will, on New Year's Day 2000, the Chatfield Arboretum be complete? Certainly not! The growth of the plant material, evolution and clarification of what the Arboretum should be and should provide, water, and the rapid changes in the last decades of the century suggest that change and development — in the Arboretum, its concepts, and its public service — will continue.

It is clear that preparation of the Master Plan is a tremendously significant accomplishment. It clarifies what the Chatfield Arboretum will be and has fired those of us who have worked with it with an increased enthusiasm. And, given the work, water, and money that will be needed over the next twenty years, the only thing greater than our enthusiasm is our conviction that the Chatfield Arboretum will be a significant contributor and cultural asset to our city, our region, and our way of life.



Chatfield Visitors' Center

Alpine Rock Garden

Under Construction

H. R. Schaal

Throughout history, alpine gardens have taken a variety of forms. Some are based upon existing natural rock outcropping, and others are completely constructed on flat sites. Many are small and made for the private garden. There are only a few which are large and for public gardens. Each type attempts to recreate one or more of the unique soil conditions found in the tundra and high mountain environments. The Denver Botanic Gardens Rock and Alpine garden attempts to create as many different high elevation growing conditions as possible.

It was readily accepted by all that Denver, as a site for an alpine garden, had distinct elevational and climatic advantages over other major botanic gardens and arboreta in the U.S. Therefore the garden should be an outstanding one, exhibiting a large collection of plants in a wide variety of natural conditions. An Alpine House "Cold House" will be a key element. Walks and paths are to permit access for handicapped persons to all portions and access by small vehicles to most areas for efficient maintenance.

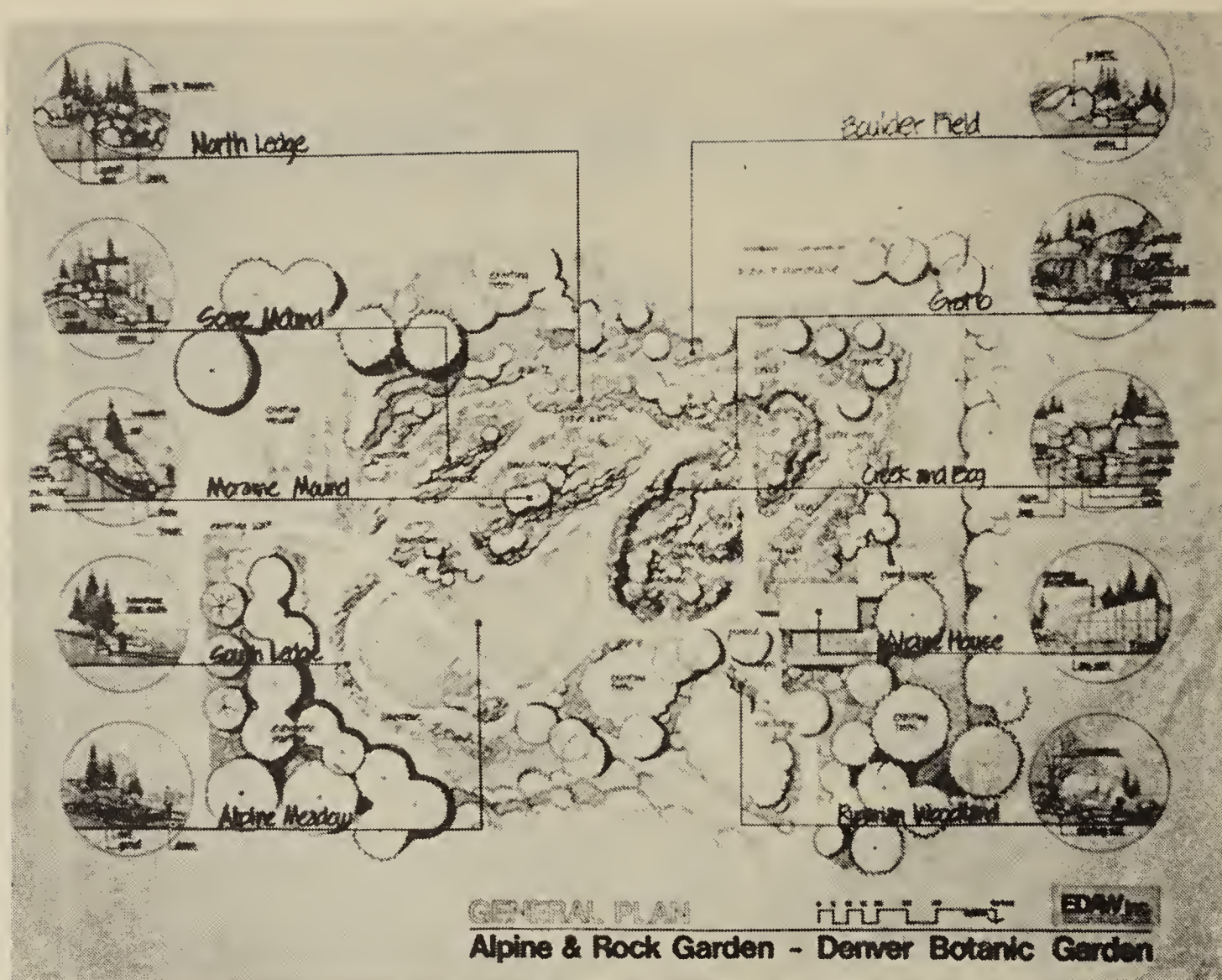
In 1976, the Denver Botanic Gardens commissioned the landscape architecture firm of EDAW Inc. to prepare preliminary design studies for the 0.86 acre Alpine and Rock Garden site in the southwest corner of the Gardens. Several work sessions between the landscape architect and the Gardens staff, the Gardens planning committee, and the CCARGA were held to establish the purpose, contents, and technical requirements.

Plans, renderings, and a model were prepared to depict the layout and based upon the landscape architect's estimate, more than \$120,000 was raised for the construction of the garden during 1977-78. Construction drawings were developed and put out to bid. Valley Crest Landscape, Inc. of Denver was awarded the project on July 27, 1978. The project is currently under construction.

Concurrent with the development of the garden, construction plans for the Alpine House are being prepared by Oliver and Hellgren, Architects.

In order to achieve the many diverse horticultural and visual conditions desired and still have a unified garden, the various main elements are carefully composed and separated from one another. A NE-SW direction is repeated in the path system and in the major fractures and rock beds to establish a degree of order. Also important to the organization of the garden is a central open space made up of the alpine meadow and

Mr. Schaal is a landscape architect with EDAW the firm which made the design and drew the plans for the Alpine and Rock Garden. He has been associated with the planning since its inception.



stream area and the strong topographic enclosure on three sides. The Alpine House provides the major focal point.

The moraine mound is the centerpiece of the garden. It occupies 1500 square feet and is six feet high. The mound is specially constructed to simulate high mountain conditions where there is a constant underground flow of water from melting snow or glacial ice. In nature, the flow of water is prevented from seeping downward by plates of solid rock. The water ultimately escapes through fissures in the rock or by surfacing in tiny streams. Some of the choicest alpine plants will not grow in any other conditions.

Our garden moraine has as its water source several buried, perforated polyethylene pipes near the top of the mound. A 30 mil PVC plastic liner at subgrade substitutes for the impervious bedrock. Surrounding the bottom of the mound is a 4" ADP drain line to carry the water away. To insure perfect drainage, there is a 12" coarse gravel bed directly over the liner. Above the gravel there is 3" of sand to prevent the soil above from migrating into the gravel. Two special soil mixes are distributed on the mound to allow a range of pH conditions. The soils are separated from each other by a plastic liner placed vertically to prevent the calcium of the higher pH soil from leaching into the adjacent soil of lower pH.

The scree mound is adjacent to the moraine mound. It covers about half the area of the moraine mound and outwardly appears the same. The major difference is that there is no underground water source or impervious liner. The drainage soil structure and soil types are similar. In nature, scree develops from accumulated materials at the base of steep slopes or cliffs and may become droughty in summer.

The trough is at the base of the moraine mound. It faces to the northwest in order to be shielded from the direct south sun. The trough gets its water underground from the moraine, but detains it in a well-drained depression. A thick layer of peat moss is at the bottom of the trough for high moisture retention.

The bog area is adjacent to the stream. It is very narrow, and about 60 feet long and two feet deep. It is constructed to retain water and to be constantly saturated, thus the drain is near the top of the basin as opposed to the trough. The bottom and sides are made impervious by plastic liner and concrete. Water enters the bog from the overflow between the rocks separating the bog from the stream. Soil is largely composed of living sphagnum moss.

The stream originates through seeps at the highest portions of the garden and winds through the center of the garden after trickling down sheer rock faces in a deep shady grotto. The rock in the grotto is comprised of large granite pieces weighing over 10 tons each. Along the stream, planting pockets are created and the stream bottom has shelves to allow various container grown aquatic plants to be placed. The entire stream bed is made impervious by concrete over PVC liner. A small submersible pump recirculates the water.

Other features include 3000 square feet of alpine meadow, 300 linear feet of ledges, 150 linear feet of cliffs, 2000 square feet of boulder fields, riparian woodlands, and walls.

The Alpine House is a specially designed, climate controlled, solar structure for propagation, research, and growing of high mountain plants which require conditions not met in the outdoor garden.

The irrigation system is controlled by an automatic timer. It is divided into 17 separate zones, based upon the soil type and aspect. All water is delivered by low pressure heads, to minimize eroding of the steep banks during plant establishment. Main lines are PVC pipe located in walkways, and laterals are flexible polyethylene pipe which wind between the rocks.



Alpine and Rock Garden
DENVER BOTANIC GARDENS EDAN inc

Twelve inches of coarse gravel underlie much of the garden area. The subgrade upon which the gravel sits slopes to a system of perforated drain lines 10 inches below the center of the gravel walkways. The drain lines lead directly to the storm sewer.

A total of about 500 tons of five types of rock was used in separate portions of the garden. The limestone, granite, and high silica sandstone have been brought from the Fort Collins area, about 75 miles north of Denver. The largest pieces weigh over 15 tons. The tufa is from Steamboat Springs, Colorado, and the pumice is from Arizona. Each of the larger rocks was examined for shape, size, and weathering in the field before selection and marking for transportation to Denver.

The planting of the garden will be a continuing project extending indefinitely. Plants will be selected from alpine and high mountain regions in the Rocky Mountains and from around the world. They will be placed in representative associations on the variety of specially prepared sites within the garden.

Among the rocks and upon the mounds will be placed a variety of diverse conifers of the following genera: *Abies*, *Juniperus*, *Picea*, *Pinus*, *Pseudotsuga*, *Taxus*, and *Thuja*. These dwarf conifers will be placed to accentuate enclosure, provide transition from the adjacent areas, and provide continuity and permanence in the planting design in contrast to the ephemeral effect of the small flowering plants.



Cones — *Pseudotsuga menziesii* Franco

African Violet Society To Meet.

THE AFRICAN VIOLET SOCIETY OF AMERICA, INC. will present the 33rd Annual National Convention to be held June 6 through June 9, 1979 at the Regency Hotel in Denver, Colorado. The local hosts are Rocky Mountain African Violet Council, and the theme chosen for the show is "VIOLETS — A PROSPECTOR'S DELIGHT."

The Show Room will be open to the public on Friday, June 8, 1979 during the hours of 9 a.m. to 5 p.m. An admis-

sion fee of \$1.00 will be charged.

The Commercial Plant Sales Room will be open to the public on Wednesday, June 6 from 10 a.m. to 10 p.m.; Thursday, June 7 from 9 a.m. to 5 p.m., and on Friday, June 8 from 9 a.m. to 5 p.m.

For further information telephone: Mrs. Carl Fussell, Convention Chairman at 781-4214; Mrs. Harry Wolf, Vice-Chairman at 722-7325, or Mrs. Michael Boster, Publicity Chairman at 979-1721.

Flowers for Alpine Gardens

D. M. Andrews

Editors' Note:

Darwin Maxon Andrews (1869-1938) was an early, internationally known horticulturist, founder of the Rockmont Nursery in Boulder. He began collecting Colorado plants in 1893, sending his specimens to Aven Nelson of the Rocky Mountain Herbarium at the University of Wyoming and to many of the famous botanical gardens in the United States and abroad. His nursery became widely known for its Rocky Mountain native plants and he was perhaps the first to propagate wild-flower seed for sale.

At the time he made the following list of alpine plants people had not yet begun to realize that Colorado's great abundance of flowers could ever be depleted, so he recommends various plants for transplanting into gardens. This practice, of course, is now discouraged, those desiring native plant gardens being urged to grow them from purchased seed. We print his list because of its comprehensive coverage of Colorado alpine plants but ask that you enjoy them in their place above the trees and do not attempt to transplant them. Most of them do not survive being torn from their native habitat.

Mr. Andrew's notes and papers, many prepared for publication, have been given to the Denver Botanic Gardens by his son Philip. The list of alpine plants which follows has been excerpted from materials which he intended to publish. Except for correcting obvious errors, we have left the paper as he wrote it.

Naturally, many of the plant names which were accepted in the early years of this century have been changed. We have endeavored to bring the nomenclature up-to-date by referring to Dr. H. D. Harrington's *Manual of the Plants of Colorado*, and Dr. William A. Weber's *Rocky Mountain Flora*. In many cases, after 50 years, the plants may be gone from the locations in which the author found them.

Allium pikeanum Rydb. from Pikes Peak, Bald Mountain, and the Arapahos, is a tiny gem of 3 inches tall which in the garden immediately grows much larger and becomes indistinguishable from *Allium geyeri* Wats. for which it should be rated a synonym. (Editors' note: Harrington so rated it in his *Manual*, 1964.)

Anemone narcissiflora L. ssp *zephyra*, flower of the west wind, is one of the features of Milner Pass in the Rocky Mountain National Park. It grows in less abundance on Cameron, Loveland, Fremont, and Independence Passes and probably elsewhere at corresponding elevations.

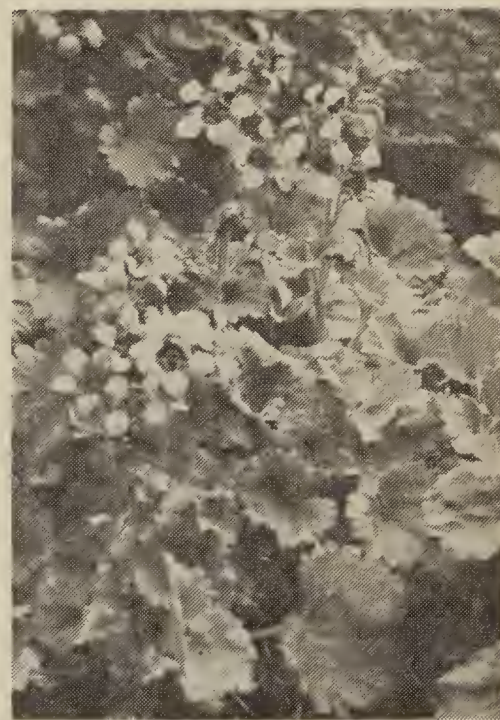
It bears its constellation of creamy stars on foot high stems from a tuft of lacinate foliage. Wrapped in a heavy mantle of snow during an augmented winter season it puts forth quickly and blooms immediately upon its release. It will grow for a time in the acid moraine but the enervating climate of even a mile above sea level reduces its flowering energy to several degrees below zero; it never has flowered in my garden. The cool alpine house offers the best prospect of success.

Aquilegia caerulea James, Rocky Mountain columbine, is the state flower of Colorado. It is best considered an alpine for culture; although it grows from foothill levels to the higher mountains, it does not require moraine treatment. It will grow in the open and unshaded garden but prefers a line of less resistance. Usually a well-drained humus soil in the lath house, or at the east side of a wall, with a resting period after flowering until cool weather in autumn will repay the care with longer life and finer blossoms.

Aquilegia elegantula Greene. Its pendulous red blossoms enclosing tints of gold, its sepals with delicate tints of green, make it a smaller edition of the Mexican columbine, *A. skinneri* Hook. It grows at middle elevations on well-drained, shaded slopes. Good care is required for success, but it is well worth while, if only for a single season.



Aquilegia caerulea



Telesonix jamesii

Aquilegia saximontana Rydb. — alpine columbine. This charming alpine takes on a different dress at every station where its habitat has given it fairway. On Arapaho Peak it grows in association with *A. Caerulea*, and although it blooms earlier, its home and habit suggest possible hybridization. The best type I have seen comes from Pikes Peak. These plants are extremely dwarf and have succeeded in a lath house without other concessions to their comfort. The flowers are small on short stems with stubby spurs, almost hidden in the rather ample foliage. Several alpine types appear to be closely related, and my impression is that most of them should be aggregated as one variable species, only the best types to receive horticultural recognition.

Telesonix jamesii (Torr.) Raf. (*Saxifraga jamesii* Torr.) is a rare alpine known only from Colorado on Pikes Peak, Mt. Garfield, and from one spot in Rocky Mountain National Park. It is not difficult to cultivate in a moist moraine, with light shade. It is nearly evergreen, 3 to 6 inches tall, with rose colored flowers. Garden or rock garden culture is not recommended.

Caltha leptosepala DC (*C. rotundifolia* (Huth.) Greene) — marsh marigold. A low subalpine for wet moraine or bog garden, it has rosettes of broad foliage, the flowers often tinged blue on the back.

Corydalis caseana A. Gray ssp *brandegei* (Wats.) Ownbey (*C. brandegei* Wats.). A large subalpine quite plentiful on Wolf Creek Pass, this plant attains 3 to 5 feet of lush soft growth, pink flowers, and several times ternate foliage. In the moraine it will survive several seasons and eventually die without flowering.

Chionophila jamesii Benth. — snow lover. A small alpine with white, penstemon-like flowers, it will grow readily in the moraine but flowers rather infrequently.

Draba streptocarpa Gray. Characteristic of many Cruciferae species, this subalpine is small, 3 to 5 inches tall, with yellow flowers and curiously twisted pods. It is rather pretty but not important.

Claytonia megarrhiza (Gray) Parry — alpine spring beauty. Rock slides of the higher mountains up to 14,000 feet are the habitats of this plant, Montana to New Mexico. It grows and flowers like a pigmy *Lewisia* from a flat rosette of spatulate leaves, flowers white. Requires moraine treatment where it grows without much difficulty and flowers freely.



Chionophila jamesii



Claytonia megarrhiza

Androsace chamaejasme Host. ssp *carinata* (Torr.) Hulten (*Drosace carinata* (Torr.) A. Nels.) — rock jasmine. A tufted umbellate alpine with small creamy white flowers, this dainty primrose is suitable for a moist moraine. I have never grown this plant but it is recommended as not difficult.

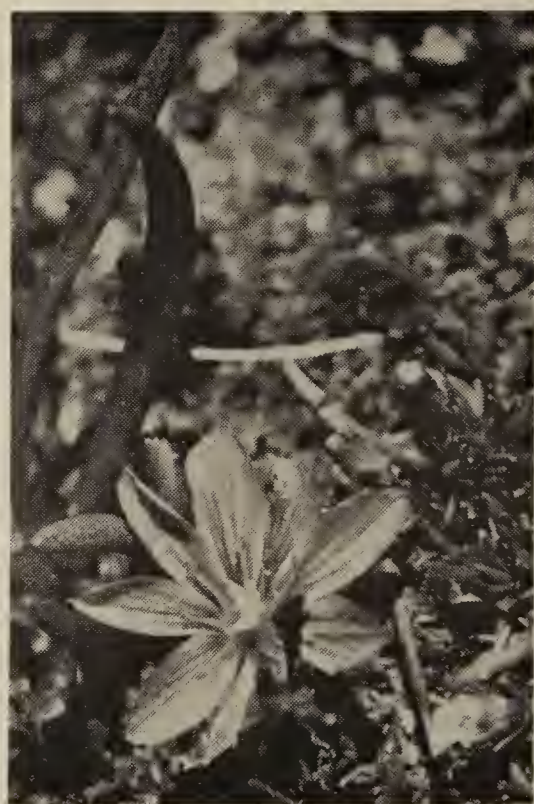
Eritrichum elongatum (Rydb.) Wight (*E. argenteum* Wight) — alpine forget-me-not.

This most delightful alpine from the highest exposed summits is a heavenly blue. Its silky foliage should be a warning of cultural difficulties which develop eventually and with certainty. In my own experiments I brought down dormant clumps in the autumn without disturbance of the roots and sheltered them as well as possible over winter. Early the next spring they commenced growth and soon there were flowers. Instead of the intense azure of an alpine sky, their color was the pale washed-out blue of an insignificant weed, without beauty. The plants failed to survive the summer after their cruel experience and I have not had the heart to repeat the experiment which I believe would be doomed to certain failure.

Erythronium grandiflorum Pursh. One of the most enchanting experiences of all my years of mountain travel was to come one day to a point on the Rabbit Ears Pass where the foreground was packed with the golden bells of this glacier lily, thence stretching to the southward in a shimmering tide of pure gold as far as the eye could reach. It is not rare at these elevations but this was truly a spectacle. Although it will survive captivity it merely produces its lanceolate foliage and usually fails to bloom.



Erythronium grandiflorum



Lewisia pygmaea

Linanthastrum nuttallii (Gray) Ewan (*Leptodactylon nuttallii* (A. Gray) Rydb.) This very hardy sub-shrub from Rabbit Ears and Tennessee Passes grows to a height of 6 to 10 inches bearing phlox-like white flowers with a rich honey fragrance. It is easily grown in the rock garden with humus soil and part shade.

Lewisia pygmaea (A. Gray) Robinson. This very hardy species of small growth with small flowers in shades of red and rose to white is easily grown in humus soil in the lath house.

Acomastylis rossii (R.Br.) Greene ssp *turbinata* (Rydb.) W. A. Weber (*Geum rossii* (R.Br.) Ser.) — alpine avens. This bright yellow member of the rose family is almost universal in the Colorado mountains at higher altitudes. Its glossy foliage and bright yellow flowers are easily produced in the lath house in a good humus soil. In preference to many alpine grasses, this plant is cut and stored for hay by the cony, a tiny rodent of the rock slides, which builds its winter nest within its store of food.

Lloydia serotina L. — alp lily. An arctic alpine plant of 6 inches may be found in Colorado, Alaska, and Eurasia. The small white lilies grow on slender stems. They are usually short lived in cultivation.



Acomastylis rossii



Lloydia serotina

Mertensia alpina (Torr.) G. Don. *Mertensias* are found from the dry plains to high alpine stations. *M. alpina* is small flowered, forms large clumps and attains its best development above timberline on Mt. Evans. It will grow and bloom in the moist, half-shaded moraine. It may be found on Arapaho Peak and Pikes Peak. (Editors' note: It is now rated as rare, possibly endangered.)

Mertensia brevistyla S. Wats. is a subalpine from the Rabbit Ears Pass Area, 6 to 10 inches tall, intense blue, and of slender growth. It has been in my garden 8 years, flowers very early, then ripens and disappears. Its place is in the shade of a low wall where its roots may avoid the heat during its dormant period.

Mertensia bakeri Greene is abundant in the mountains of northern Colorado and will grow in the lath house. It is very dwarf, the leaves quite silvery and silky, and the flowers intense blue and profuse.

Primula angustifolia Torr. One of the tiniest of alpines with a small rosette and a few showy crimson-red blossoms with a central yellow star is found on Arapaho, Pikes Peak, Mt. Evans and other high places in the central Rockies. It grows and flowers with surprising ease in the moist moraine with half shade.

Primula parryi Gray. Subalpine to the high alpine zone, it likes wet rocks and cold streams. It is a larger edition of *P. Angustifolia* but far more difficult to grow. Good flowering is seldom obtained in cultivation, probably due to too dry conditions with insufficient soil acidity.

Pulsatilla patens (L.) Miller (*P. ludoviciana* (Nutt.) Heller) grows abundantly at the plains level in Colorado and extends to the higher mountains; also, via the Black Hills it reaches eastward to Wisconsin. Its refractory disposition under cultivation favors alpine treatment rather than that of the ordinary rock garden.



Primula parryi



Pulsatilla patens

Ranunculus adoneus A. Gray — arctic buttercup, snow buttercup. This is one of the few plants that will flower while the roots are encased under the thin icy edge of alpine snow. The yellow flowers are large and showy; the plant grows well in the moraine but often the flowers are much reduced in size. It requires very acid soil.

Ranunculus eschscholtzii eximius (Greene) L. Benson. Distinct in foliage and flowers, the latter not so large as in *R. adoneus*, this buttercup is rare. The same culture is suggested but not proven experimentally.

Ranunculus macauleyi A. Gray. This very showy buttercup from the eastern slope of the Sangre de Christo Range has the same dwarf habit as the above but differs in foliage. This most attractive species is quite dependable in a moist moraine.

Clementsia rhodantha (A. Gray) Rose (*Sedum rhodanthum* A. Gray.) — queen's crown — is rather similar to *R. integrifolia*, but larger. The flowers, which at high altitudes are deep rose, fade to pale pink in cultivation. Needs moist moraine and full sun. It may be found in the high mountains from Colorado to Montana.

Silene acaulis L. — moss campion. This is a plant of wide distribution and quite variable. The Colorado plant is very dwarf, forming low mats, which in the moraine grow easily but flower much less profusely than in nature. This is a desirable plant and seemingly distinct from commercial forms.

Smelowskia calycina (Dev.) C. A. May (*Smelowskia americana* Rydb.) Notable for its sweet fragrance, Siberian *smelowskia* is a cruciform plant, dwarf, and quite easily grown, with clusters of white flowers. Loveland Pass, Grays Peak.

Besseyia alpina (Gray.) Rydb. (*Synthyris alpina* Gray) — kitten tails. An elegant plant with rosettes of dentate foliage and small spikes of amethyst-purple florets, it is easily grown in the moraine with half shade.

Thalictrum alpinum L. Alpine in form, with maiden hair foliage, this *Thalictrum* remains very tiny, 3 to 4 inches. Usually found below timberline, it grows without difficulty in the lath house if kept fairly moist.



Clementsia rhodantha



Viola adunca

Viola adunca Smith. ssp *bellidifolia* (Greene) Harrington is a little caespitose subalpine violet recommended for alpine culture. Its flowers are blue. Redrock Lake in Boulder County.

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The Ancient Alliums

Evelyn F. Johnson

Gardeners are becoming increasingly aware of the decorative value of the alliums, perhaps better known as flowering onions. Their unusual form and size of the heads of bloom and height of the flowering stems make these onions stand out in an extraordinary fashion in the garden. They have a long blooming season, and as an additional bonus the flowers are followed by ornamental seed heads, decorative for another long period.

The onions make up a large genus of plants. Over 500 varieties are known. They have played an important role in the life of mankind and have been mentioned by most of the ancient historians. A great many varieties originally came from Asiatic countries, where for centuries they have been grown as an important food. They also have been considered to have great medicinal value. They even have had religious significance. Some of the ancient inhabitants of Egypt worshiped the onion and were not allowed to use it as food. Pliny, the Roman historian, tells us that the Egyptians invoked the onion in taking an oath.

Leeks, onions, and garlic are mentioned in the Bible. We are told that when Moses was leading the Israelites out of Egypt they complained bitterly



Allium giganteum

Mrs. Johnson was a gardener of considerable renown in the Denver area. She also wrote a number of articles for *The Green Thumb*. It seems appropriate to mark her recent lamented passing by re-printing the article below which she wrote for the Winter 1969 Issue of *The Green Thumb*.

to him, saying: "We remember the fish which we did eat in Egypt freely; the cucumbers and the melons, and the leeks, and the Onions and the garlic. But now — there is nothing at all but this manna."

The Greek historian Herodotus wrote that it took 9 tons of gold to pay for the "pungent onions" required to feed the slave workers who built the pyramids. These were the Egyptian multiplier onions, *Cepa viviparum* L., which may not be known to modern gardeners, although they can be found growing in our area. I remember seeing them in my childhood in a garden in eastern Colorado — brought here by early settlers from the East, along with cabbage rose, tansy, ribbon grass, and other old-fashioned plants.

This Egyptian onion produces little green bulblets at the *top* of leafless flowering stems instead of blossoms. It is unusual and attractive growing at the back of the perennial border with its bouquets of little green onions (bulblets) in early spring. Culture is the same as the ordinary green garden variety.

Another *allium* with an old history is the leek, *Allium porrum* L. Emperor Nero is said to have eaten leeks three times a week to improve his singing voice. Leeks are an important food in Asia and Europe where leaves and stems are made into stews. The leeks are quite ornamental in our gardens with their huge white or sometimes lavender blossoms that last for weeks in mid-summer.

The familiar chives, *Allium schoenoprasum* L., with deep green clumps of grass-like foliage and lavender-blue flower heads, makes an attractive low border. Chinese chives, *A. tuberosum* Rattl. ex K. Spreng., has wider leaves and fragrant white blossoms. Both bloom in July and August.

Historically, *alliums* have been grown for food, but modern gardeners now have an extensive list of varieties which

are planted only for their decorative value. They vary in appearance, size, and time of bloom, so that just the right one can be found to fit into any spot in the garden.

The tall sorts usually have wide basal leaves out of which grow slender leafless stems topped by huge compact flower clusters resembling floral balls. The colors may be white, shades of purple, lavender, or pink.



Allium sp.

It is this tall leafless stem (or scape) with its flower ball at the top which makes the *allium* stand out with such a dramatic effect — much like an upside-down exclamation point. At any rate the sight of these extraordinary blossoms causes many exclamations.

Some of the dwarf kinds can have wide leaves, but most of them make clumps of narrow grass-like foliage. All carry their ball-shaped blossom heads on characteristic leafless stems.

Alliums grow from bulbs, and most varieties are as hardy as tulips; like tulips they should be planted in the fall. They need only an ordinary well-drained soil in either sun or very light shade. Fortunately, the more expensive varieties are quite effective planted singly among other perennials or in groups of two or three. The smaller, more dainty sorts are better planted several in a group. These look well at the edge of a border or in the rock garden.

A list of about twenty of the decorative varieties can be found in some bulb catalogues. *Allium rosenbachianum* Regel., one of the earliest to appear in spring, produces a rose-purple compact ball in late May. June-blooming, *A. aflatunense* Regel. is similar, but taller and deep violet in color.

Perhaps the most spectacular variety is *Allium giganteum* Regel., a huge bulb from Tibet, which has been named

Jewel of Tibet here in America. It has a 5 or 6 foot bloom stalk with an enormous deep lavender ball.

One of the most unusual and popular varieties is *Allium albopilosum* A. Christophi, called Stars of Persia — a very apt name. The flower head looks like a bursting skyrocket of silver-lilac stars. Even the dried seed cluster retains this appearance.

Among the dwarfs, one of the brightest is *Allium moly* L., golden garlic. It should be planted in groups in the border or rock garden. *A. ostrowskianum* Regel. makes beautiful rose-colored drifts, and one of the loveliest of all is *A. azureum* Pall., the blue garlic, with its clear blue brilliance.

Allium sphaerocephalum L. has a wine-colored cone-shaped ball. *A. karataviense* Regel. is an eye-catcher in spring, with its three wide, blue-green leaves edged with red that lie close to the ground. A gray-pink ball rises to 10 or 15 inches.

One of the latest to bloom is *Allium triquetrum* L., appearing in August and September. It has three-cornered stems and small white clusters of flowers striped with green.

In addition to their spectacular displays in the garden, *alliums* provide outstanding material for the flower arranger, either when freshly cut or when dried for winter arrangements. The dried seed heads can be used in their natural fall colors or sprayed gold or silver.

Alliums' one drawback that might keep some gardeners from planting them is that all are onions and have the characteristic scent of onions. This, however, is not particularly noticeable unless the plants are touched. For most people their unusual and extraordinary decorative value far outweighs this characteristic. More and more gardeners are discovering these magnificent plants and using them.



Seed head of *Allium albopilosum* A. Christophi, 'Stars of Persia.'

The Tradescant Trust

Josephine Robertson

Anyone who enjoys finding the perky little *Tradescantia virginiana* L. blooming in the garden on a summer morning has a link with the unique new garden center and Tradescant Memorial Garden which are in process of creation beside the Thames in London.

I learned of it first through an item in the *London Times* last December and since we were spending Christmas in London, walked across Lambeth Bridge to old St. Mary's Church where, in the churchyard, the Tradescants, father and son, are buried. St. Mary's, formerly a parish church at the gates of Lambeth Palace, is a handsome stone structure built on 6th century Saxon foundations, but is one of many churches which in dignified British parlance have been declared "redundant."

It was a cold, wet day, impossible for photography. As we approached we saw a surprising number of forlorn men and women around the doors. Nearby was a large banner saying "Crisis at Christmas." Inside the church, from which the pews and ecclesiastical fittings had been stripped were portable heaters, stacks of mattresses, and a crew of dedicated social workers in charge of bedding down in this temporary shelter as many as six hundred of London's homeless each night.

Mrs. Robertson is a graduate of Vassar and attended the Columbia University School of Journalism where she earned the degree of B. Litt. She is a free-lance writer whose main interests are gardens, travel, and people.

In the walled churchyard there was evidence of cultivation in garden beds near the handsomely sculptured tomb of the Tradescants who had had a famous garden nearby in Lambeth in the early 1600s. Another former resident of Lambeth rests nearby in a marble sarcophagus — Captain Bligh of H.M.S. *Bounty* fame.

Two years ago Rosemary and John Nicholson, interested in garden history, sought out the Tradescants' tomb and were shocked to find it completely covered with dirt. Their concern sparked the founding of the Tradescant Trust, a registered charity with two aims: to convert the church into a gardening information and conservation centre and museum; second to create in the churchyard a memorial garden planted with the species of shrubs and flowers brought to England by the two men.

Between them they introduced so much new material that they were said to have laid the foundations of English gardening. Hundreds of items came from the continent and ninety from Virginia. Their garden was the first great public garden attracting visitors from many countries.

The father's first important gardening post was with Robert Cecil, First Earl of Salisbury, who commissioned him to landscape the grounds of Hatfield. Some of this still remains and furthermore, a quaint likeness of the famous gardener is carved on the newel post of the great stairway.



Tradescantia occidentalis Smyth

After his patron's death Tradescant moved to Canterbury which gave his son John, then fourteen, the opportunity for a good education, but the boy soon turned to the garden world. His father, whose fame had grown, finally worked for the king and created a magnificent garden at Oatland for Queen Henrietta Maria. This was later destroyed by Cromwell. The father died in 1638 while young John was making the first of three trips to Virginia.

Among the items brought from America — in addition to the spiderwort *Tradescantia virginiana* L. — were the scarlet runner bean, New England asters (which became Michaelmas daisies), Canada lilies, evening primrose, the showy cardinal flower, coneflower, Virginia creeper, the red columbine,

swamp cypress, red maple, tulip and plane trees.

It must be mentioned that the older Tradescant, while plant collecting abroad for his wealthy patrons, also collected curios — any kind of oddity such as rocks, shells, coins, stuffed birds, from Russia "shoes to walk on snow without sinking," a Duke of Muscovy's gold embroidered vest, and the horn of a unicorn, later conceded to have come from a narwhal. The collection was displayed in Lambeth as "the Ark" and as the first museum in England became famous. The contents were ultimately acquired by Elias Ashmole and became the nucleus of the Ashmolean Museum in Oxford.

Work on the garden has already begun through the cooperation of some leading nurserymen, and an appeal is under way to raise £250,000 necessary for converting the church to its new use. The Queen Mother is deeply interested in the project and the trustees include David Piper CBE, director of the Ashmolean Museum, the Nicholsons, Mea Allan, biographer of the Tradescants, many titled and eminent persons of church, state, the arts, and the garden world, and Christine Bland Martin representing the Garden Club of America.

A number of interesting benefits was on the calendar during the summer of 1978. Further information may be obtained from Mrs. Nicholson, the Tradescant Trust, 7 the Little Boltons, London SW10 9LJ.

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A Tribute To

Dr. Ernest H. Brunquist

Dr. Ernest H. Brunquist, 1888-1978, always declared himself to be a "Hobby Botanist" but he had begun the subject with a scientifically trained mind and years of teaching experience at the University of Colorado Medical School.

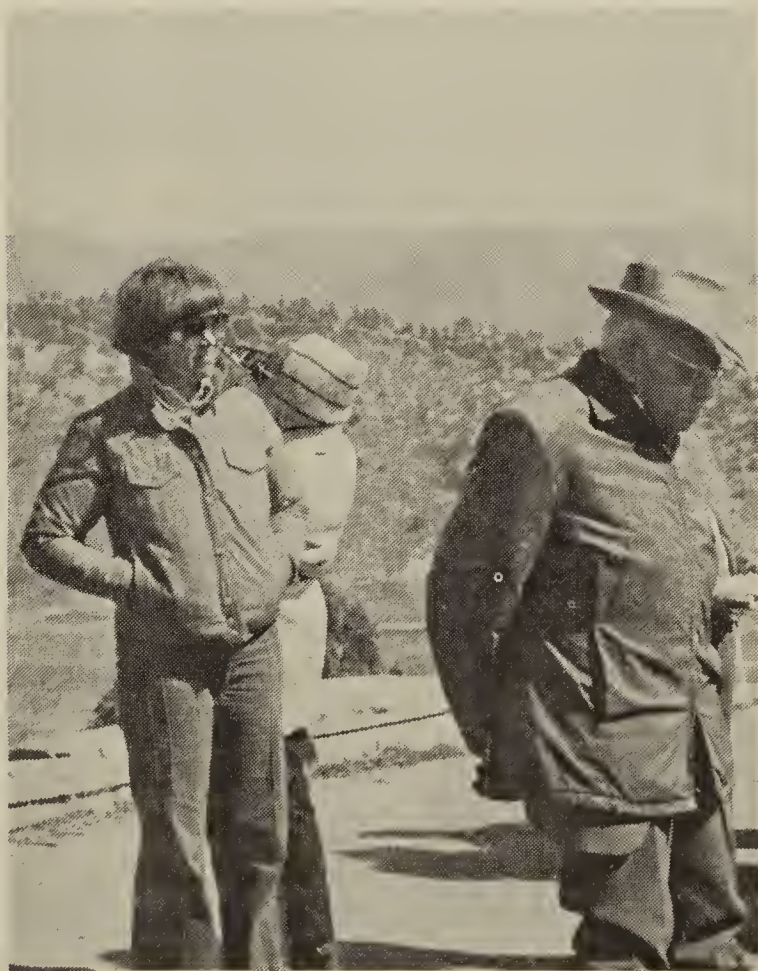
In the early forties, there was an organization called "Colorado Seminar in Botany." This was headed by Harold D. Roberts as President, and Joseph Ewan as editor of the bulletin which was published for several years. Dr. Brunquist was a member of this seminar.

He was also an active Colorado Mountain Club member. My first introduction to Colorado flowers was on a Mountain Club trip led by him in 1948. At that time Dr. Brunquist was leading several flower trips each year for the club.

As time went on, he became interested in forming a Botany Club and collected names and addresses of people who might be interested. In May 1955 an announcement of an organizational meeting was sent to this list for a meeting to be held June 7, 1955. It was headed "It's in the Bud — A Botany Club." It had been arranged that the club would be sponsored by the Mountain Club. But, at the well attended meeting, the majority of interested persons were members of the Colorado Forestry and Horticulture Association. Thus began Dr. Brunquist's

association with an organization which merged with Denver Botanic Gardens.

After retiring in 1956, Dr. Brunquist began spending much time learning more and more about Colorado flowers. One of his great pleasures was to accompany Dr. H. D. Harrington of C.S.U. on his collecting trips. He did much collecting himself and his specimens are now incorporated in the Herbarium at Botanic Gardens.



Dr. Brunquist Leads a 1977 Field Trip

In 1958, the gardens acquired the Mt. Goliath area much of which is above timberline. The trails were laid out by the U.S. Forest Service. Dr. Brunquist joined the regular trips along with Dr. A. C. Hildreth, Dr. Helen Zeiner, Joseph Oppe and others to examine and identify the plant life along the trails. Dr. Brunquist did some extra work by himself and compiled several lists of the plants there.

With the organization of the Botany Club, Dr. B., as he was affectionately known, began making lists for trips and information sheets for the meetings and trips of the club. These sheets and lists continued as he began trips for Denver Botanic Gardens to acquaint interested persons with local flora. In recent years, these sheets became the basis for a talk given as a prelude to the trips which he led. He was a familiar figure in the library on Tuesdays, working until he joined the Herbarium committee for lunch.

Dr. B had a delightful sense of humor which was an outstanding part of his personality. This humor, together with his patience and interest in passing on his love of living things, made him very beloved by all who were associated with him. He was a shining example of a person enjoying a useful retirement.

Over the years, hundreds of persons who went on his Plant Life Field Trips know more of nature lore because of his teachings. His influence in passing on his knowledge and love of the outdoor world will go on like the ripples from a stone dropped into still waters.

Marjorie L. Shepherd

Mrs. Shepherd's relationship with the Denver Botanic Gardens began in the days of the Colorado Forestry and Horticulture Association when she and Dr. Brunquist were instrumental in the formation of the Botany Club and when she worked with many others toward a Denver Botanic Gardens. She is a volunteer in the Kathryn Kalmbach Herbarium.



Dr. Brunquist and Young Friends

Focus on

Guaiaecum officinale

in the

Boettcher Memorial Conservatory

Peg Hayward

Guaiaecum officinale L. is a small, slow growing tree indigenous to a region ranging from South America via the West Indies to Florida. There are many of these trees in Jamaica, where it is the national flower. The early Spaniards called this tree *lignum vitae*, which means "wood of life" because of supposed medicinal properties. Infusions of the bark and leaves were believed to restore vigor, so it is associated with legends of Ponce de Leon.

The evergreen *lignum vitae* is grown as an ornamental and timber tree. It reaches a height of 30 feet. The smooth bark of the tree is variegated with green and white. This dense crowned tree's

attractive foliage is made up of opposite pinnate leaves, each with two pairs of oval, blunt leaflets. Clusters of delicately fragrant, felty blue flowers, which rapidly fade to almost white, are borne at the branch tips. Each flower has five spreading petals about a half inch long and ten stamens. The tree blooms and fruits more or less continuously throughout the year, often displaying flowers and fruits at the same time. The fruit is a rounded, bright yellow, five-celled, five-angled capsule less than 1 inch across. When ripe it splits open to expose bright red seeds.

Lignum vitae, the heaviest of all commercial woods, is of great economic importance. The greenish-brown wood will sink in water, having a specific gravity ranging between 0.95 and 1.25. The most important use of the wood is for bearing or bushing blocks lining the stern tubes of propeller shafts of steamships. The great strength and tenacity of

Mrs. Hayward has been active in Denver Botanic Gardens for many years. She has been a leader in the preparation of *The Conservatory Guide* and in the training of guides. Her article "Focus on" has been a feature of many issues of *The Green Thumb*.



Guaiacum officinale

the wood, combined with the self-lubricating properties due to the resin content, make it especially adapted for bearings under water. Being impervious to water, the wood is irreplaceable in its use in shipbuilding. Dried it is used for cogs, rollers, mallets, rulers, bowling balls, and wood turning.

Tear-shaped drops of gum guaiacum can be collected from the bark of the tree. The fragrant resin has been used in medicine for centuries. Lignum vitae sapwood contains a high concentration of saponins, as well as resin, volatile oil, and several organic acids. A decoction of the wood removes most of the saponins, which were found to be effective in treatment of syphilis by West Indians in 1514. News of this treatment was spread to Europe, where an epidemic of syphilis had been raging since 1493. Use of the decoction for this purpose continued until 1909 when a more effective drug was introduced.

Another member of the Zygophylliaceae, caltrop family, which

may be seen in the Boettcher Memorial Conservatory is *Bulnesia arborea*, (Jacq.) Engl., known as vera or verawood. The tree has little resemblance to lignum vitae as it has finely cut pinnate leaves and brilliant yellow flowers. Verawood is used for the same purposes as lignum vitae but is not considered its equal for bearings. Both lignum vitae and verawood make lovely ornamental trees in spite of their slow growth.

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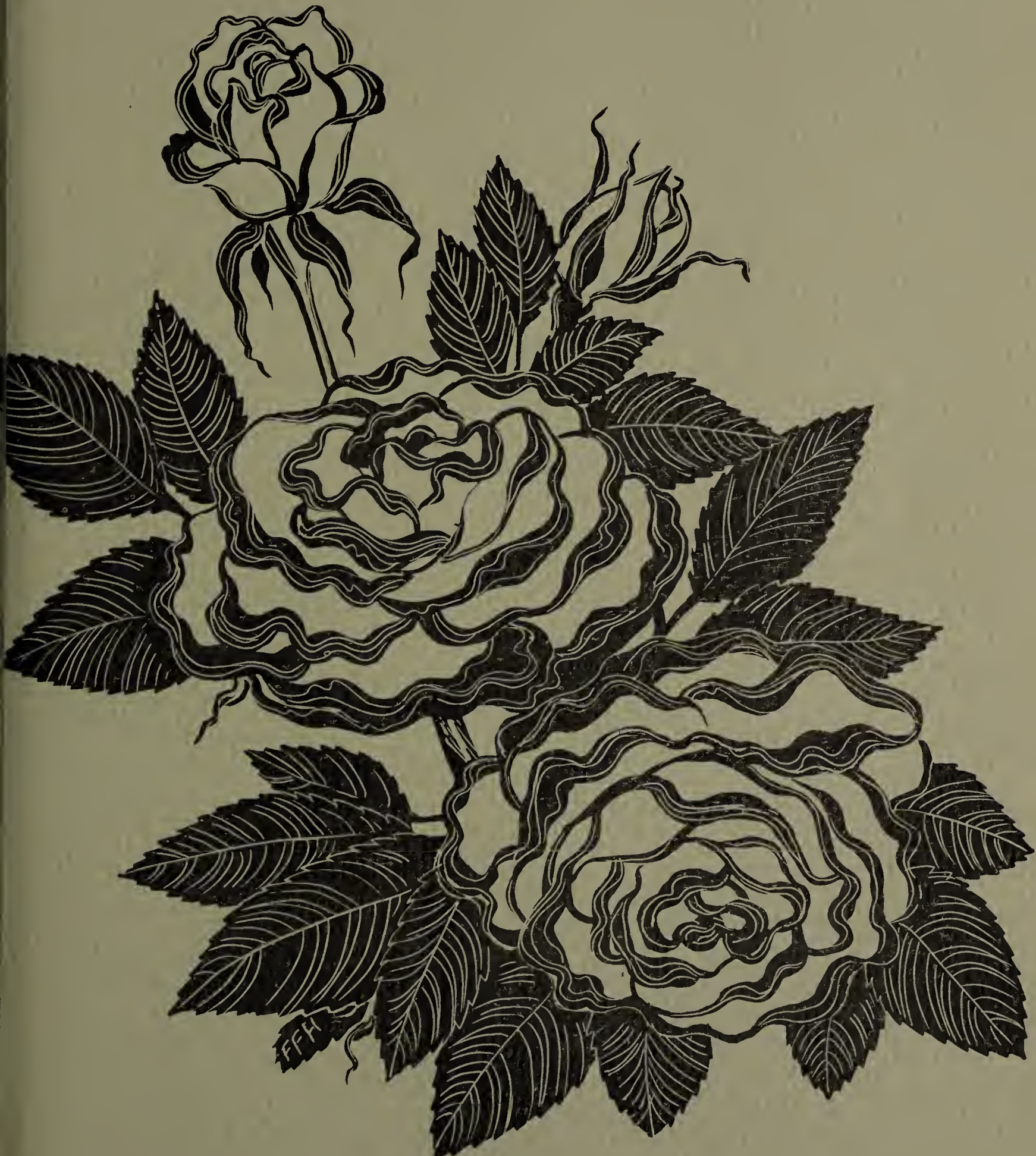
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THE COVER

The Queen of Flowers

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William H. Anderson, Jr.
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Editors

SUMMER 1979

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Botanizing in Saudi Arabia

Virginia McConnell Simmons

"The Arabian Peninsula is a land composed almost entirely of desert, mostly of a barren and stony type, with an abundance of sand in the southeast."

This description from a popular world atlas surely does not sound like the Garden of Eden, although a few people believe that Saudi Arabia was the home of Adam and Eve. For centuries, in fact, the tomb of Eve was a major attraction in Jiddah on Saudi Arabia's Red Sea coast. Prior to moving to Saudi Arabia, I had few preconceptions about what to expect, but my rather pessimistic frame of mind at that time leaned toward the interpretation presented by the atlas more than that by the Book of Genesis.

A glance at library shelves will quickly convince any botanist, whether a professional or an amateur like me, that the literature about Arabian flora is as scarce as the vegetation itself is purported to be. Discouraged that I would be able to identify the few plants there, I nevertheless packed the only three books in my library which seemed relevant — the three-volume *Handbook of Succulent Plants* compiled by Hermann Jacobsen. Difficult as it is to apply to a geographic study of flora, the *Handbook* proved very helpful . . . later.

Our new home was in Jiddah, a rapidly growing city with a university, foreign embassies, headquarters for many research programs, and a large number of Europeans and Americans. Yet, the city has no public library. It does have a few bookstores, though. Efforts to find plant guides in these shops were futile. In fact, only a few titles about any Arabian subject, whether published in Arabic or English, are available in retail stores. When a British woman living in Riyadh wrote and privately printed a book on the wild flowers of central Arabia in 1978, her contribution was as happily received as rain on the desert. In addition, there was a handful of articles which had appeared during the past decade in the occasional issues of the *Journal of the Saudi Arabian Natural History Society*. Botany had not been a significant interest among the members of this society, however.

Mrs. Simmons is a local writer who has been much interested in the Botanic Gardens. Others of her articles have been printed in *The Green Thumb* and she has contributed to other natural history journals.

Originally sponsored by the late King Faisal, the Natural History Society is a small organization made up principally of English-speaking residents of Jiddah. Among these members was Patsy, an Irish nurse, who enjoyed studying native succulent plants. And Patsy had a neighbor, Sheila, who also studied succulents, but Sheila lived most of the year in England, where she managed the family farm. However, during her prolonged absences Sheila obtained plant identifications at Kew Gardens' herbarium and conveyed her findings to Patsy. Through such contacts, I gained a repertoire of about a dozen plant names with which to confront the Arabian Peninsula during my first months there. On the whole, it was not an auspicious beginning.

Still, I had one significant advantage. To travel in Saudia Arabia is an uncommon opportunity. One does not enter the kingdom as a tourist as a rule, and women do not travel without their husbands or some other responsible male escort. Fortunately, my husband's work entailed generous periods of time in the field, and I was able to accompany him. Several weeks were spent on the upland plateau east of the range of mountains which runs the length of the peninsula on its western side. The plateau's elevation, approximately a mile high, affords study of many plants which are absent from the hot coastal plain at sea level, where Jiddah is located. Another field camp was situated at about 8,000 feet in the mountains. While at this beautiful camp, surrounded by junipers, I had opportunities to observe vegetation at different elevations from the camp down to sea level on the west flank of the mountain range. In addition, there were auto trips along the length of the coastal range, weekend excursions along the Red Sea coast, and vacations in the Yemen Arab Republic (North Yemen) and Jordan, the latter involving travel through the northern area of Saudi Arabia. Although I did not visit central or eastern Saudi Arabia, these journeys revealed the surprising variety of succulent plants native to the western side, at least, of the peninsula. Arid it was, rocky it was, sandy it was, but barren it was not.



Opuntias Under Cultivation in the Arabian Mountains

Under these circumstances I felt duty-bound to put forth some serious effort to compile a list of Arabian succulents. To overcome my initial ignorance of plant names — even generic names — I began by reading Jacobsen's three volumes, species by species, and preparing a card file of species ascribed to Arabia. Most entries for Arabia actually are from North and South Yemen, where the principal botanic studies have occurred, so an awareness of climatic and other geographic conditions is necessary in using Jacobsen for this purpose. Photographs of specimens which my husband and I observed were incorporated in the file. The photos were of surprising assistance, for they could be studied at leisure for comparison with descriptions in the card file, and some prints even were mailed to the British Museum for verification of identifications. Eventually, as additional literature was made available, cards were prepared for any Arabian succulents mentioned therein. As a result of this file plant recognition became easier for me, and it was possible to compare the findings of taxonomists whose work has been published.

Conspicuously absent from this method are scientific procedures for the identification of plants, but the preparation of a file of cards and photographs is an exercise which I would recommend to other people confused by unfamiliar flora in strange lands. Furthermore, collecting cards and photos is less likely to involve trouble with the law than collecting plants themselves, especially for exportation. Most amateurs can learn as much by taking notes in the field as by studying uprooted specimens anyway.

As my project and consequent knowledge progressed, it became possible for me to communicate by letter with a modicum of botanic intelligence. At that stage correspondence with the staff of the British Museum (Natural History) became very helpful, particularly as it provided me with some hitherto elusive references. Foremost were plant surveys published in Oxford University's *Journal of Ecology* and the *Journal of South African Botany*. The former provided excellent descriptions of the plant associations of different regions of Saudi Botany, while the latter described new species of aloes in Yemen.

The presentation here of the species names compiled in my file will indicate to those who have not visited Arabia the abundance of succulent species to be found there. Also, the list will show the preponderance of particular genera. Readers who have traveled in East Africa will recognize some kinship with vegetation there, for the Arabian Peninsula is in the same floristic zone. In this short article I will not attempt to include plant descriptions or observations other than the few comments to be found in brackets.

CHECKLIST OF SUCCULENT PLANTS OF THE ARABIAN PENINSULA

AGAVACEAE

Sansevieria ehrenbergii Schweinf. [Not a true succulent.]

APOCYNACEAE

Adenium arabicum Balf.



Adenium arabicum

ASCLEPIADACEAE

- Calotropis procera* Ait. [Not a true succulent.]
- Caralluma adenensis* Bgr.
- Caralluma arabica* N. E. Br.
- Caralluma baldratii* White et Sloane
- Caralluma cicatricosa* N. E. Br.
- Caralluma luntii* N. E. Br.
- Caralluma pencillata* White et Sloane
- Caralluma retrospiciens* N. E. Br.
- Caralluma sinaica* (Decne.) A. Berger
- Caralluma subulata* Decne.
- Duvalia* sp. [Reported informally.]
- Echidnopsis bentii* N. E. Br.
- Echidnopsis nubiea* N. E. Br.
- Echidnopsis seutellata* Bgr.
- Huernia macrocarpa* var. *arabica* (N. E. Br.) White et Sloane
- Leptadenia pyrotechnica* (Forsk.) Decne. [Not a true succulent.]
- Sarcostemma* spp.
- Sarcostemma viminale* R. Br.

CHENOPODIACEAE

- Suaeda fruticosa* (L.) Forsk.
- Suaeda monoica* Forsk.
- Suaeda* spp.

COMPOSITAE

- Senecio anteuphorbium* Schultz-Bip.
- Senecio pendulus* Schultz-Bip.
- Senecio sempervivus* Schultz-Bip.

CRASSULACEAE

- Cotyledon barbeyi* Schweinf. et Penzig
- Crassula alba* Forsk.
- Kalanchoe alternates* (Vahl.) Pers.
- Kalanchoe teretifolia* Deflers
- Umbilicus rupestris* (Salisb.) Dandy

EUPHORBIACEAE

- Chorozophora obliqua* (Vahl.) A. Juss. ex Spreng.
- Euphorbia arabica* Hochst. et Steud.
- Euphorbia cuneata* Vahl
- Euphorbia aegyptiaca* Boiss.
- Euphorbia ammak* Schweinf.
- Euphorbia cactus* Ehrenbg. ex Boiss.
- Euphorbia cactus* var. *aureovariegata* Schweinf.
- Euphorbia dracunculoides* Lam.
- Euphorbia fruticosa* Forsk.
- Euphorbia grandicornis* Goebel. [Informally reported.]
- Euphorbia granulata* Forsk.
- Euphorbia helioscopia* L.
- Euphorbia hirta* L. (*E. pilulifera* L.)
- Euphorbia inarticulata* Schweinf.
- Euphorbia isthmia* V. Tickh.
- Euphorbia kahirensis* Raeusch. (*E. cornuta* Pers.)
- Euphorbia pareiramulosa* Schweinf. (?)
- Euphorbia peplus* L.
- Euphorbia schimperi* Presl.
- Euphorbia scordifolia* Jack.
- Euphorbia tenuirama* Schweinf.
- Euphorbia terracina* L.
- Euphorbia thi* Schweinf.
- Euphorbia triaculeata* Forsk.
- Phyllanthus rotundifolius* Klein ex Willd.

LABIATAE

- Coleus arabicus* Lour.

LILIACEAE

- Aloe bainesii* Th. Dyer
- Aloe barbadensis* Mill. (*A. vera* L.) [See *A. vera* var. *officinalis*]
- Aloe fleurentinorum* Lavranos et Newton
- Aloe inermis* Forsk.
- Aloe pendens* Forsk.
- Aloe rivierei* Lavranos et Newton
- Aloe rubroviolacea* Schweinf.
- Aloe sabaeola* Schweinf.
- Aloe speciosa* Bak.
- Aloe tomentosa* Defl.
- Aloe trichosantha* var. *menachensis* Schweinf.
- Aloe vaccillans* Forsk.
- Aloe vera* var. *officinalis* [Still believed to be valid by some botanists. See *A. barbadensis*.]

MESEMBRYANTHEMUM

- Aizoon canariense* L.
- Aizoon hispanicum* (?)
- Lampranthus roseus* (Willd.) Schwant. [Appears to be an erroneous identification.]
- Mesembryanthemum nodiflorum* L.
- Trianthema portulacastrum* L. (*T. monogyna* L., *Sesuvium portulacastrum* L.)

PASSIFLORACEAE

- Adenia venenata* Forsk.

PORTULACACEAE

- Portulaca oleracea* L.
- Portulaca quadrifida* L.

VITACEAE

- Cissus quadrangulus* L.
- Cissus rotundifolia* Forsk.

ZYGOPHYLLACEAE

- Zygophyllum simplex* L.

Although I hope that this checklist will be of help to people who are interested in Arabian flora, it should be used with an awareness that all of the species cited have not been verified by my own observations in the field. Further, one must assume that additional species exist on the Arabian Peninsula.

Besides the native succulents many exotics have been imported, principally for ornamental purposes. Another use has been for food. We saw many *Opuntia* cacti under cultivation, their fruit being a popular item in local markets. In many places the *Opuntias* are naturalizing, and they appear to have become a serious pest in parts of North Yemen. In Yemen we also saw sisal *Agaves*, both cultivated and naturalized.

Clearly, the Arabian Peninsula is host to a wide variety of succulent plants. Anyone who has an opportunity to investigate them will come away convinced that this corner of the world is a Garden of Eden for botanists.

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What is Blooming in the Galápagos?

Dorothy B. Scott

A trip to the Galápagos Islands with members of the Denver Botanic Gardens would be something to look forward to at any time, but during the hard winter of 1978/79 anticipation really peaked. It was not surprising that we were all early for our flight to Miami, Feb. 2, the first leg of our journey. Representing Denver Botanic Gardens and of great help to us all the way, and not just botanically, were Dr. Moras Shubert and his very charming wife, Erne.

Arriving in Miami we were driven to the late James Deering's sumptuous winter home, Vizcaya, for an afternoon visit. The Italian Renaissance style villa was built between 1914 and 1916 and contains many art treasures of the 15th through 18th centuries. The gardens are formal with low, shrubbery-lined flower beds, fountains, pools, and sculptured figures in strong contrast to the native jungle area bordering the driveway. These raised areas, with thick undergrowth, we learned, are

Mrs. Scott is an amateur gardener who acquired her love for gardens and plants from her father when she was a child in England. She can remember lupines in his gardens that were taller than she. She first became interested and involved with the Denver Botanic Gardens when she went on the English Gardens Tour in 1976.

called hammocks. The property borders Biscayne Bay, a location hard to fault.

Sunshine the following morning did full justice to Fairchild Tropical Gardens as we took an introductory tram ride through this tropical garden comprising 83 acres of beautifully landscaped group plantings interspersed with long vistas and lakes, all designed by William Lyman Phillips. The plants are clearly labeled and readily accessible for viewing, a fact appreciated later as we wandered through on foot with a volunteer guide whose enthusiasm for the garden added so much to our own enjoyment. The world famous Montgomery Palmetum has about 500 species of this economically important and lovely plant. Only a few species can grow in temperate zones — here they all luxuriated. The cycad collection also is very extensive and one of the largest in the world. Pointing out some in bloom, our guide noted their history goes back to the end of the age of dinosaurs, but locally they have more recent and amusing history. They were milled for flour but the odor was so objectionable that the neighbors complained and milling had to stop. Bromeliads grew everywhere, or so it seemed, on and

among rocks, even over a doorway and especially in the artificially watered rain forest. Here the growth, both under and on the trees, was abundant, making it a cool, quiet, area to pause to admire orchids in bloom overhead. Further along the path, agaves bordered one side and, in subtle contrast, aloes from Africa the other. The red silk cotton tree (*Bombax ceiba* Burm.) was in bloom and very striking indeed with its blood red blossoms, thick and waxy and up to four inches across, standing out against the blue sky. Philodendrons thickly covered some of the tallest trees. This is the only area in the United States where they grow outdoors all year, reach maturity, flower, and set fruit. The rare-plant house shelters such plants of special interest as the breadfruit tree, giant tree ferns, bromeliads, and orchids. Our guide pointed out something we would have missed: we were standing at an elevation of 18 feet, one of the highest points in southern Florida!

We crossed the equator without note on our flight from Miami to Quito. Needing something more tangible we drove north over a modern toll highway and old cobblestone and dirt roads to the village of San Antonio de Pinchincha and a privately owned, tiny, observatory built exactly on the equator. Here the days and nights share nearly equal time and words such as solstice, equinox, and equator had full meaning. Ecuador means equator (as we might have guessed!) and boasts it is able to grow anything due to its great range of climates.

Finally the Galápagos, reached by air via a short stop in the port city of Guayaquil where we rushed to buy Panama hats. Six hundred miles west across the Pacific, the island of Baltra is not too inviting: warm, dry, and flat with gravelly soil, *Opuntia* cactus and a few wrens taking the tourists in stride. The airstrip was built during WWII by American troops and at this time the native,



The Group at the Equator

land iguanas were exterminated. It was good to board the 900 ton M/V Iguana, our home for the next week.

Extremely smooth seas, fine weather, and excellent meals made shipboard routine very easy. After dinner one of our three guides (all trained and licensed at the Darwin Research Station by the Ecuadorian National Park Service) lectured and showed slides of the next day's morning and afternoon calls, not forgetting to let us know if it would be a beach (wet — meaning roll up pants and plastic-bag cameras) or jetty (dry) landing by panga (outboard motor boats).

The Galápagos group consists of thirteen major islands and many more islets. The oldest islands were formed by the uplift of lava flows originally on the ocean floor while the newer ones are volcanoes formed above sea level. Geologically this is still a very active area with earthquakes common and more volcanic eruptions, possibly, than anywhere else on earth. A volcano on Isabela, the largest island (1803 sq. miles), was erupting when we arrived but disappointingly, not visible. The geological turbulence of these islands is attributed to their tectonic movement across a 'hot spot' as they approach the west coast of South America at the rate of five centimeters per year. (Editors' note: See Lucian Long's article, this issue.) Endemic became the most used word, usually in reference to a species but sometimes to a genus of plant or animal not found anywhere else in the world. (For brevity EG will be used for endemic genus, ES for endemic species.) Everything possible is being done to preserve the ecological balance of these remote islands which means that, for example, not one film wrapper is dropped, shell or seed taken home, or animal touched. Goats, pigs, dogs and even donkeys introduced by whalers and other seafarers, are now wild on some islands causing serious overgraz-

ing and death to tortoise young. Some tortoise species were exterminated as seamen in the early days piled them on board for fresh meat supplies. Seeds were brought to the islands by birds, ocean currents, and floating islands of vegetation from the mainland. There are very few pollinating insects.

Islands named after early day heroes are now known by Spanish names with few exceptions. Isabela (Queen) beat out Albemarle (Earl of) and Santa Cruz took over for the tonguetwister Indefatigable. It is amusing that Guy Fawkes, who tried to blow up Parliament in 1605 and whose day is still celebrated with fireworks by British schoolchildren, has managed to keep his very small islands!

With so many Sally Lightfoots skittering over the black rocks and diverting our attention, it was amazing our first landing was dry. Bright red, small, and indigenous, these crabs were numerous along rocky coastlines and would be fascinating even without their inspired name. Our path to the cone of an old volcano on Bartolome was over sharp, purplish-red lava, crisscrossed occasionally by crumbly lava tubes, with a few *Coldenia* and *Chamaesyce* shrubs existing on spartan soil. Hardest of all, on bare rock, were clumps of lava cactus (*Brachycereus*, an EG). The view from the top looking over to immense lava fields on Santiago was most impressive. The somewhat erratic El Nino current from the north which brings the annual warm, rainy season from Dec. to May, had warmed the ocean here and gave us a perfectly memorable swim from a fine sandy beach shared by a couple of young pelicans patrolling overhead.

An overnight cruise brought us to lovely tree and shrub lined Tagus Cove on Isabela, a fine deep anchorage much used by whalers in the early 19th century. The dates they scratched into the soft rock behind the landing are not too conspicuous, but the paint used nowa-

days to record names on the cliffs certainly is and weathers all too well. Here we saw our first Blue-footed Boobies doing their slow march steps, a pair of endemic Galápagos Penguins (the most northerly of any penguins due to the cold Humboldt current), flightless cormorants turning to dry their featherless wings which look more like flippers, and marine iguanas sunning on the rocks. Ashore we hiked past salt water Darwin Lake edged by the soft new green of Palo Santo trees (*Bursera graveolens* Triune & Planch), *Cordia lutea* L., with bright yellow flowers, *acacia rorudiana* Christoph. and Galápagos cotton (*Gossypium barbadense* var. *darwinii* L.) and much, much more as mockingbirds and finches, oblivious of us, kept busy with springtime chores.

Equally disinterested and mostly taking siestas, were the sea lions at Punta Espinoza on Fernandina where they favored shady spots under red and white mangrove trees. Even more numerous were marine iguanas. We had to step carefully to avoid their burrows along the beach which was dotted by clusters of *Cacabus meirsii* Wettst, in bloom.

The Islands' only raptor, a Galápagos hawk, posed for us at length before we went in search of a well known local character named Oscar, a very fine land iguana who lives alone miles away from his kind. His orange-brown skin with bright yellow crest is photogenic enough but the mystery of how he got there and why such solitude, fascinated everyone.

The remains of buildings left from an aborted Norwegian salt mining operation in the '20s gave James Bay a ghost town look. Mist covered the highlands, as it had everywhere else, but the landscape looked very inviting with gently sloping green hills and fine sandy beaches. Walking along the remains of an old road we again saw Palo Santo trees, very spiny *Scutia pauciflora* G.



Bursera graveolens

Don shrubs and dainty, flowering *Chrysanthellums* before reaching a smooth lava rock area next to the ocean. Here scatterings of volcanic rock balls of various sizes, called bombs, and their resultant polished depressions melted into hardened lava and called crucibles, were numerous in an area of beautiful tidal pools and grottos filled and emptied by the ocean.

Espumilla's gently sloping beach looks tranquil enough but one member will always remember its engulfing, wet, welcome! Button mangrove and *Maytenus octogona* DeProd. with its thick leaves vertical to lessen exposure to the sun, lined the beach. A short way through them was a large lagoon often home for flamingoes but then home for only a yellow-crowned night heron near us and a couple of feral goats browsing on the other side. A pretty little tree with bright, shiny leaves and small apples caught everyone's attention.

Hippomane mancinella L. shouldn't even be touched as it is quite poisonous. Higher along the brick red, narrow, trail we were stopped by the light scent of the delicate blooms of *Clerodendron molle* Jack. Resting under a large *Pisonia* (ES) tree so like a friendly old apple tree, we found it hard to imagine this verdant area as it would be later in the year with gray-white tree limbs bare to the sky.

Tree-like *Opuntia* dotted the slopes of South Plaza Island and provided shade for the land iguanas who enjoy eating them, especially the blossoms. Finches seemed to be impervious to spiny shrubs as we saw them perch on the *Opuntia* to survey our progress. Somehow they get through the spiny dense branches of *Castela galapageia* Hook. (ES) and *Scutia pauciflora* G. Don. to eat the fruit. *Sesuvium edmonstonei* Hook. (ES), green at this time of the year, matted the ground — it would be bright red later on. At the top of a dangerously eroding cliff we watched Red-billed Tropicbirds, Swallow-tailed Gulls and Magnificent Frigatebirds put on an incomparable aerial display above an ocean clear enough for us to see brightly colored tropical fish. An unforgettable spot.

Jasminocereus cacti stood, as though on guard, at the top of a receding cliff across from the jetty at Puerta Ayora, Santa Cruz, while the village itself was alight with flowering Royal Poinciana trees and vines. From here we went on a botanical trip by bus to the highlands through farmlands with coffee, banana, pineapple, coconut, papaya, guava, avocado, balsa, and citrus trees as well as castor bean. Highlights along the way too were a *Datura* tree in perfect bloom, feathery-leaved, fast growing *Cedrela* trees and sticks of *Jatropha curcas* L. pushed into the ground to form living fences — just the way Robinson Crusoe did! Cattle are the main crop and are ready for market

earlier than normal on a diet rich in bananas. Tethered donkeys and goats helped trim roadside growth but happily, were not close to a lovely blue hydrangea. Finally, we reached our destination — the *Scalesia* zone and the large sinkholes, both remarkable. The *Scalesia* trees (an EG, woody sunflower) have hairy leaves bunched at the tips of branches and formed forests as far as we could see. Only when the plant is young does it resemble the sunflower we know. Its flowers are small and white. Some of the rich flora identified included: *Phoradendron henslovii* Robinson, *Darwinothamnus tenuifolius* Hook., *Jaegeria gracilis* Hook., all endemic, *Solanum nodiflorum* Desv. ex Dun, *Phytolacca octandra* L., *Pectis linifolia* L., and a tight group of lycopodiums at the edge of a sinkhole looking like a Rocky Mountain scene in miniature. The near perpendicular rock walls of the sinkholes were well over one hundred feet deep and more than that across and apparently, not of volcanic origin. A Vermilion Flycatcher added his brightness to a scene we had to leave far too soon. Even then it was too late for a visit to the Darwin Research Station along the bay from the village and so we regretfully missed seeing the tortoise who gave their name to these Islands. Because they live in isolated groups around individual craters, different species have evolved which are now being bred at the Darwin Research Station for reintroduction.

Our last stop was at Punta Suarez on Hood Island where a whole nursery of young sea lions entertained us and one another. A short walk through *Grabowskia* shrubs brought us to Masked Booby pairs (the largest of the boobies) close by and even on the path, taking turns incubating their customary two eggs. Further inland more Blue-footed Boobies were doing the same, equally undisturbed by our coming.

Here again we saw *Sesuvium edmonstonei*, *Opuntia*, *Cryptocarpus*, and *Lycium minimum* C. L. Hitchcock — with such sharp thorns! From here we headed back to Guayaquil.

Russian cars added their bit to the congestion and noise of Guayaquil as we drove to the airport for our flight back to Quito. More memorable was the sight of young Royal Poinciana trees just coming into bloom in the median of a busy street. In Quito we had a fine tour of that interesting city, especially the old part. Founded by the Spanish in the 16th Century but actually dating back to 1500 B.C., it has a wealth of

architecture (including about 60 churches) and history to absorb. One large church, heavily embellished with gold donated by many benefactors, was without lights because of the area's current electric power shortage. On the plus side this meant there weren't any garish electric signs. Other commercial signs are being gradually replaced by beautifully simple wrought iron ones.

Home the next day via Miami with grateful thanks to many who made our trip such an outstanding success but most of all to Dr. and Mrs. Shubert for their unfailing help and thoughtfulness.



Travelling Through *Sesuvium*

Plate Tectonics and Plant Migration

Lucian M. Long

Plant migration has been one of the subjects under study by earth scientists for most of civilized time. Now a new tool has been added which will probably be as useful as the concept that the earth is round instead of flat. It has been a slow process, but finally the world now realizes that the land masses on earth have not always been where they are now.

My own thinking, and that of most scientists, has been clouded by trying to visualize the natural history of earth by applying present-day conditions on the past. Of course such thinking is excusable because no one had really dared to express anything to the contrary until 70 years ago when a U.S. geologist, Frank B. Taylor, suggested that the continents as a whole might have moved.

As early as 1620 Sir Francis Bacon had speculated that the similarity of shore lines of Africa and South America could scarcely be an accident. However it remained for a German meteorologist, Alfred Wegener, in 1912 to propound the notion of Continental Drift in detail. He spent the rest of his life until his untimely death in 1930 trying to convince the world his idea was sound, but alas the concept was all but forgotten until after World War II.

My own interest was first aroused over 40 years ago when I studied geology at the University of Colorado. At the time they were teaching that mountains were formed by shrinkage as the earth cooled, with resulting wrinkling. They also believed that as the tops of the mountains were eroded away and silt was carried to the plains the shift of weight pushed the mountains back up again. It just didn't happen that way!

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Of course there have been slight readjustments, especially when large ice sheets melted, but the amount of uplift is not enough to explain the mountains. Even today geologists are more concerned with the age of the rocks, concentrating on establishing the period when they were deposited — usually below sea level — rather than when the uplift occurred.

Fortunately there have been men like the wealthy, amateur naturalist, Charles Darwin, who broke away from world dogma to get closer to the truth. Upsetting the common notion that all species had been created simultaneously in their present form, he startled the world with his publication *The Origin of Species* in 1859.

Now it is well recognized that when a plant is isolated in a limited area it begins to have slightly different characteristics after a period of years. When that period is extended to millions of years new species develop which are endemic to that area alone, but still retain some of the original characteristics.

In further search for the truth it is much easier to visualize the concept of plate tectonics if we start at the beginning instead of at the present time. There were many theories for the origin of earth, but the most persistent one is called the “big bang.” This theory has just recently extended the date for the origin of the universe to 20 billion years ago, based on new radio telescope evidence.

Presumably the earth was first a blob of gas, turning to liquid as it cooled. It formed into a ball because of its own gravity. Finally a thin crust of solid rock formed on the surface about 4½ billion years ago. The oldest rock discovered so far is 3.98 billion years old which was found in Greenland, a relatively stable area with a minimum of distorting forces.

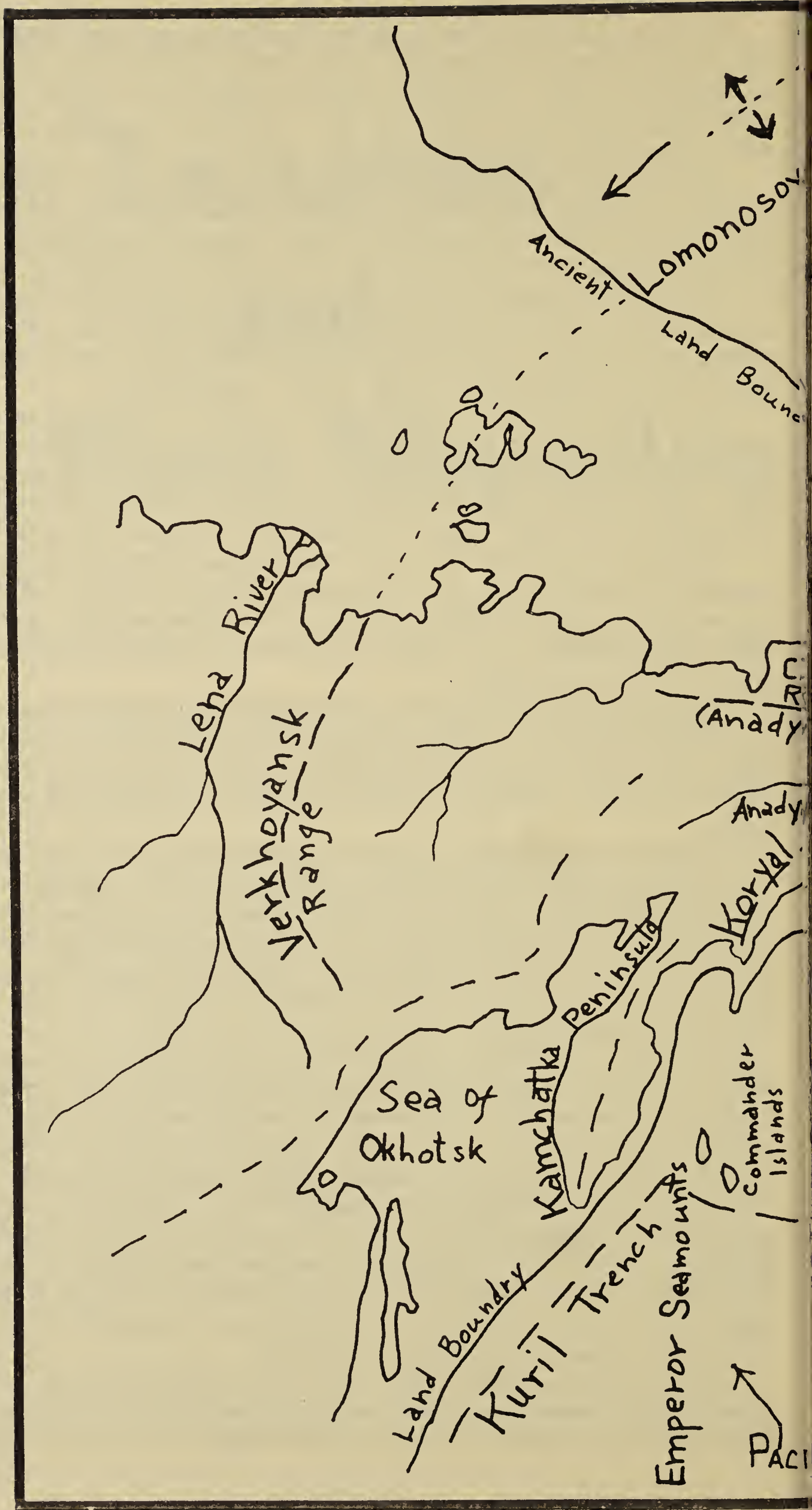
The period between 4 billion and 600 million years ago is shown in rocks all over the world. However the rocks are so twisted and distorted that they don’t tell us much except that the world was still very hot and mountains were formed by very active convection currents. As soon as they were uplifted the process of erosion began.

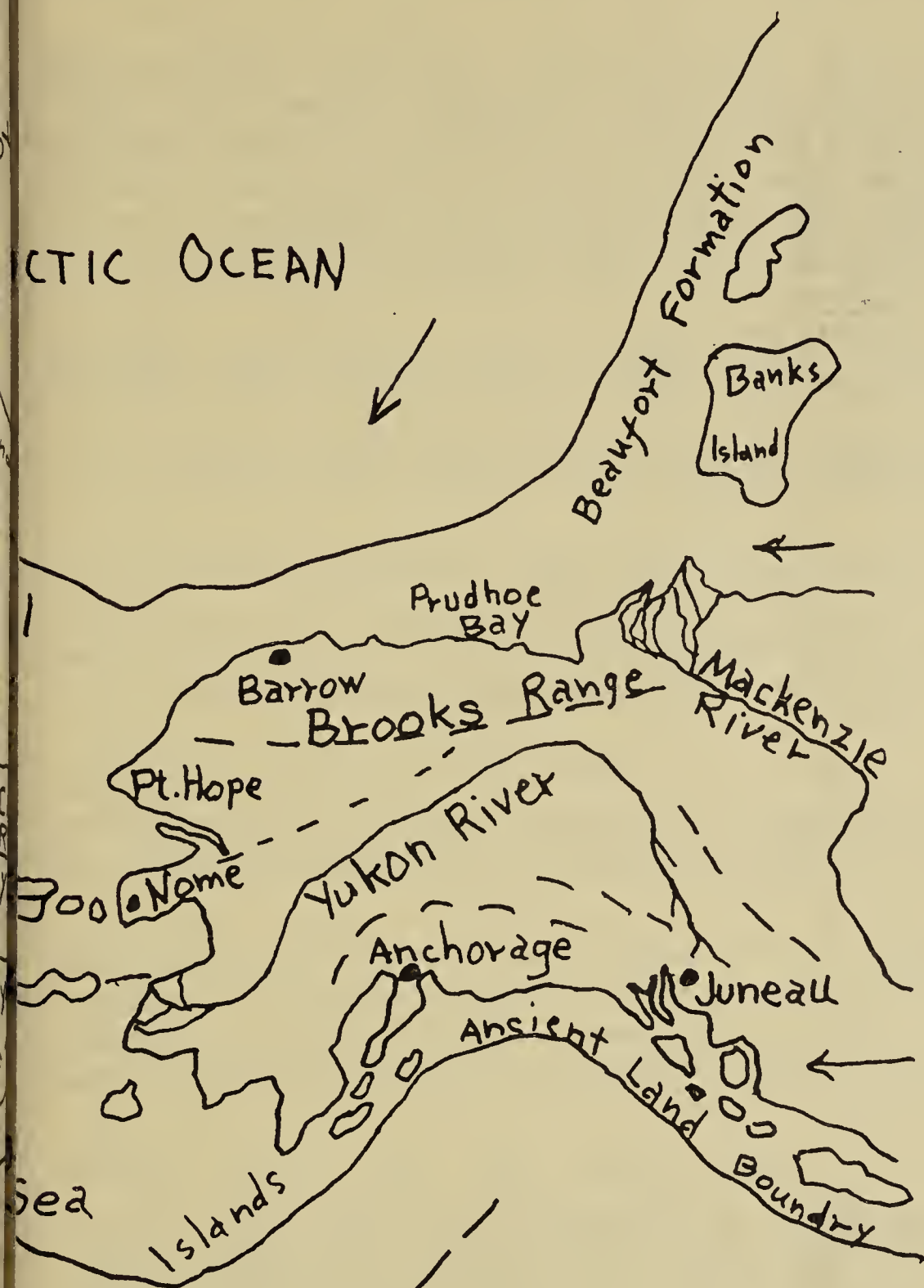
Somewhere during the early portion of this vast time the miracle of primitive life occurred. On the shores of Lake Superior scientists have found fossils of blue-green algae about 2 billion years old. This algae produced the first oxygen in the atmosphere or else large animals would never have evolved. Scientists believe they have duplicated part of this life process in the laboratory with amino acids. Perhaps if they recreate the exact conditions for 3 billion years they will be able to produce life as we know it today.

Finally the bubbling stopped and for unknown millions of years the mountains were eroded by streams until they were almost flat, barely above sea level. Some of the last of these sediments can be seen in the dark red core of the Uinta Mountains of northwestern Colorado and in other areas of western North America. This quiet period of geological history is known as the “Lipalian Interval.”

As we enter the Paleozoic Era, about 570 m.y.a. (million years ago) we can begin to visualize the scene. The world was covered with lots of islands. They were absolutely barren rocks, flattened by stream erosion to nearly sea level. The average air temperature was probably 70° F. (12° warmer than today). Summer and winter were nearly the same and there was still very little oxygen in the air. However there was plenty of carbon dioxide for the plants.

Soon the sea was filled with small conical-shelled mollusks, brachiopods, and trilobites (now extinct). As those small animals lived their life cycle and died, the shells fell to the bottom of the sea and mixed with very fine sand grains from





ARCTIC PLATE
45-12
MILLION YEARS AGO

exposed rocks to form our first fossilized rocks. These can be seen in Williams Canyon north of Manitou Springs and several other places in west-central Colorado.

The continents had not yet taken shape but new forces were becoming significant. The earth's crust was cooling and getting thicker and beginning to crack. The area which is now Colorado was located on the equator. A "transcontinental arch" extended from Colorado east (now northeast) across the Canadian shield of eastern Canada to Greenland. This was the bulge caused by centrifugal force at the equator. The "Colorado sag" permitted the sea to encroach from the northwest (now west) into central Colorado.

By 450 m.y.a. seas also had encroached from the southeast (now east) and divided Colorado into parts by a sea through central Colorado. Then the seas receded slightly, possibly because a large ice dome formed in the area which is now Algeria, Africa, part of the Sahara Desert. It was not desert then — it was at the south pole!

By now the seas were almost crowded with snails, echinoderms, sponges, and cephalopods in addition to the earlier marine plants and animals. Soon the first fish developed and the mollusks had grown quite large. Still the land was barren and molten magma from the earth's core came up to seal the cracks as fast as they opened.

Sea shores began to have primitive plants, but there is less evidence preserved. The true slime molds (*myxomycetes*), a fungus with properties that resemble both plant and animal (*protozoa*), are living remnants and must have been among the first land plants.

Major cracks were developing in the earth's crust all over the world and large areas of land and sea were drifting like ice blocks in the arctic. A large area including North America and at least the northern part of South America was drifting generally southeasterly. Along the leading edge was Ireland, Northern Scotland, and Norway, mostly below sea level.

Sometime about 400 m.y.a. this extremely large plate collided with the European-African plate in one of the largest collisions of Earth's history. It even bounced Europe into Western Siberia forming the Ural Mountains. Possibly Antarctica, Australia, India, and New Zealand were also attached to South America and Africa, but this information is not as well established, partly because the motion was slower. It is even possible the southern half of South America and Africa were also involved in a separate plate action with the others.

To the north massive ridges were pushed up, mostly from below sea level, forming extremely high mountains which have not been worn away completely in 400 million years of rain and snow. Apparently the northern parts of the plates touched first which formed the Appalachian and Scandinavian mountains and gave the North American plate a counter-clockwise twist.

The western part of the North American plate was largely unaffected and much of the area west of the present Lake Erie was below sea level. Although the land was still barren there were a few amphibians, scorpions, and land snails along with the first traces of land plants, fungi, lichen, liverwort, seedferns (now extinct), and many other small plants.

Much Plate Movement

Although this is strictly my own theory, I believe that Asia took shape between 350 and 400 m.y.a. from at least five smaller plates. The first event was when western Siberia joined Europe as mentioned earlier. A portion of central Siberia apparently was added later. Then an area of Mongolia, Sinkiang, and China collided and pushed up a tremendous range of mountains, squeezing together several seas including the world's deepest lake, Lake Baikal, 5315 feet deep. Fossils are different on the east and west sides of this lake. Next, eastern Siberia and a portion of Alaska got squeezed together between North American and Asia. Finally, India came north rapidly and bumped into the entire mass. This event about 40 m.y.a. was the most recent of plate tectonics, and has been widely recognized.

The period from 350 to 135 m.y.a. was a great time for the development of plants and animals as we know them today. Not only was it a time when most of the land flora and fauna developed, but all the major continents were attached in one large area, thus permitting easy spread of new species.

The first major split was between 200 and 180 m.y.a. when Africa, with South America still attached, broke away from plates of the northern hemisphere. Part of Florida and some of the east American coast, originally a part of Africa, remained with North America after the split.

Up to the present time orchids have been thought to be a little over 50 million years old, since the only fossil orchid discovered so far is from the Eocene Epoch (*Protorchis monorchis* Schmidt and Schmidt). However orchids must have been well established at least 200 million years ago when this split occurred. At that time they were mostly, if not entirely, *Monandrae* (one fertile anther). There are many genera represented throughout the southern hemisphere, including several we have in Colorado, but the species are different. There are even two species in Australia which grow mostly underground. The *Diandrae* (two fertile anthers) which includes the *Cypripedium* must have developed later in the northern hemisphere.

The genus *Malaxis* is an anomaly since there are about 200 species distributed widely around the world, but not in Africa. Only two species are known each in Europe and Australia. There must be some other explanation.

The Cactaceae are strictly a native American plant family. They probably originated in tropical Central America about 80 m.y.a. although fossil cacti have been found in Colorado in the shales of the Uinta basin near the Utah border which may be as old as 100 m.y.

The only cactus known elsewhere is the genus *Rhipsalis*, an epiphyte with white berries which were probably carried by migratory birds to Africa and Ceylon (now Sri Lanka). Cacti are found in the rain forests of South America, but they must have migrated after the Isthmus of Panama was formed about 30 m.y.a.

Cacti are not old enough to have developed many endemics. However Dr. Moras L. Shubert, on the editorial committee of *The Green Thumb*, has just recently returned from the Galapagos Islands and reports two endemic genera and an endemic species with several subspecies of cacti. Otherwise climate and

environmental differences have been the main factors in determining location of individual species.

Up until 80 m.y.a. Colorado and the entire western area of North America had been almost untouched by plate tectonic activity. About 300 m.y.a. there was a wrinkle which produced two ridges and valleys which geologists call the Ancestral Rocky Mountains and about 30 million years later a vast area from eastern Tennessee to northeastern Pennsylvania was subjected to extensive folding and thrust faulting.

Since there was very little plant material to hold the soil, and some of the rocks were not yet well cemented, the Ancestral Rockies were quickly eroded. Much of the material is included in the Pennsylvanian conglomerate of the Front Range which forms the Flatirons near Boulder and the Hermosa formation in southwest Colorado.

Colorado was carried by the North American plate to the vicinity of the Tropic of Cancer and from 250 to 150 m.y.a. was desert, much like the Sahara today.

About 140 m.y.a. North America moved further north and the climate became wetter. There were tropical forests of cycads, palms, conifers, and young redwoods. Dinosaurs roamed the beaches and forests and then the sea moved in. From about 125 to 80 m.y.a. most of Colorado was covered by the sea.

As the mountains were formed the climate became dryer and forests changed to mesic broadleaf types including poplar, hackberry, pine, and redwoods. Remains of this forest and insects of the period are preserved in volcanic ash near Florissant and near Creede. The Florissant Fossil Beds National Monument is considered one of the best areas for fossils in the world. It was formed between 30 and 60 m.y.a. when lava from several volcanos formed a lake, and ash fell trapping leaves and insects. There are trunks of very large redwoods and even stumps still in place.

Our link with Eurasian plants was severed 80 m.y.a. when the North American plate pulled away from Europe and headed west. In the beginning the main Pacific plate was drifting due north. As the floor of the Pacific was subducted beneath North America, mountains were pushed up in eastern Nevada and western Utah during the first 8 million years. Geologists call this period the Sevier Orogeny. Mountains were formed all along the west coast of North America. The major uplift occurred during the Laramide Orogeny from 72 to 45 m.y.a. and then stopped abruptly.

We have to look to the north to see the reason the uplift stopped so abruptly leaving the very impressive front range in dramatic contrast to the plains. As the North American plate travelled west a smaller plate to the north of Greenland broke off and moved even faster, rotating very slightly counter-clockwise, until it was squeezed between North America and central Asia. This plate included Kamchatka and eastern Siberia from the Lena River. The western part of Alaska from east of Prudhoe Bay diagonally to somewhere east of Anchorage was also included. Thus the northern end of the Appalachian mountains wound up as the Verkhoyansk range in Siberia!

The floor of the Arctic ocean continued to move and formed the Chukchi (sometimes called Anadyr) range in Siberia and the Brooks range in Alaska by subduction. The northern slope of the Brooks range consists of treeless tundra with Arctic flora including many circumpolar species. There are small, isolated stands of alder and poplar which have migrated through the passes. There is at least one other stand of very old trees near thermal springs which are headwaters of small rivers.

The combination of squeezing and subduction formed the Alaska range including the Wrangell and Cugach mountains. In eastern Siberia the Koryal range curved east and formed the St. Lawrence Island, completely blocking what is now the Bering Strait. Even the direction of the Pacific plate was changed. After a period of confusion

it drifted west and finally settled on a northwestern course. The history is recorded in the Emperor Seamounts which finally resulted in formation of the Hawaiian Islands.

After the collision of North America with Asia about 45 m.y.a., North America has been decelerating until now it is moving at about one inch a year. There were many after effects of subduction, most noticeable for the first 10 million years. During the uplift there had been tremendous batholiths where the molten lava came very near the surface of the mountains. In Colorado the oldest is the Boulder Creek granite. Next is the Pikes Peak granite and the youngest is the Silver Plume granite.

There were numerous domes ahead of the subduction zone. The most obvious is the Black Hills bubble which is 120 miles east of the mountains and was uplifted at least 7500 feet exposing rocks about 2.6 billion years old. Volcanic activity was most pronounced in Colorado from 40 to 8 m.y.a., but continued near Aspen and McCoy until 1.5 m.y.a., and finally stopped near Dotsero only 4,000 years ago.

As the rocks cooled vertical faults up to 10,000 feet in the Gore and Uinta mountains occurred between 30 and 20 m.y.a. Then general uplift of the entire region, including adjoining states, from 3,000 to 5,000 feet continued until about 10 m.y.a.

A fault zone developed through central Utah and extended along the Idaho-Wyoming border, culminating in the upthrust of the Grand Teton range in Wyoming. The time of this upthrust was only a few million years later than the faulting of the Bering Strait 12 m.y.a. Continuation of this fault zone to the north is the cause of the Yellowstone activity.

The last stages of mountain building activities are the thermal or hot springs and are still evident today. Ninety per cent of the hot springs of the United States are in the west. Colorado has 44 while California, Nevada, and Idaho each has about 200. Northern California has had volcanic activity within this century at Mount Lassen and volcanic vents at Mount Shasta because of the slippage between the North American and Pacific plates.

South America split from Africa about 135 m.y.a. but was travelling so slowly it has nearly been stopped merely by friction as the Pacific plate slid under the west coast. A link with North America was established about 30 m.y.a. when the Isthmus of Panama was uplifted by a segment of the Pacific plate.

Early Effect on Botany

Probably the first botanist to recognize the effect of plate tectonics, although the concept was unbelievable at the time, was Professor Asa Gray, for whom Grays Peak in Colorado was named. In 1857 Gray was asked to study the extensive botanical collections brought back from Japan by the expeditions of Commodores Perry and Rodgers. He was more familiar with the plants in the east coast regions so he selected 300 species from a similar temperate region of Asia. Since only 100 of these species appeared on the American west coast he concluded that there was a remarkable resemblance between existing plants of eastern Asia and those of eastern North America.

Gray realized that European forests had been very much like ours before the glacial advance but that many of the species did not return to Europe as the ice retreated. He was especially impressed by fossils in Europe which were almost identical to the *Sequoia gigantea* Endl. of California. He believed that migration must have been through the arctic regions and even expressed the possibility that ocean-gaps may have been bridged over.

In a lecture delivered before the Harvard University Natural History Society in 1878 he concluded, "When we know, moreover, that sea and land have varied greatly since these species existed, we may well believe that any ocean-gaps, now in the way of equable distribution, may have been bridged over."

As early as 1937 Eric Hultén, world famous botanist, was probably the first to establish definite proof of the botanical link between Asia and North America. He spent nearly fifty years in the study of arctic plants and in 1968 published his *Flora of Alaska and Neighboring Territories*. He described the mixed mesophytic forests extending from Japan to Oregon. This forest began to change to a boreal forest after the Bering Strait was formed. He indicated that Beringia, as he called it, was land during the early and middle Tertiary periods. This date would be about 20 million years too soon, but he had no other way of determining it.

Beringia was under intensive study by a group of international scientists during a symposium held August 25 to September 5, 1965 at Boulder, Colorado. This symposium was organized by David M. Hopkins, of Menlo Park, California, a research geologist with the United States Geological Survey. He had been studying the "Bering Land Bridge" for 20 years and helped Hultén with the preface of his book. Early in 1967, before the plate tectonic theory was fully accepted, he published his own book, *The Bering Land Bridge*, describing, among other things, how dispersals of beaver and flying squirrels indicated vegetation during one period when Beringia was land, and how marine fossils all over the world provided nearly complete records for dating periods of open sea.

With slight modification of dates at the beginning we now have the story. Land contact with Asia was established about 45 m.y.a., but was broken by faulting about 12 m.y.a. in the area of the Gulf of Anadyr and then further northeast. Land was established again about 9.9 m.y.a. until 4 m.y.a. It was this period when Beringia was covered with muskeg vegetation of birch, aspen, alder, willow, and other low growth. Then the Bering Strait opened more widely from 4 to 3.5 m.y.a. Due to a major ice age which lowered sea level all over the world, Beringia was land again from 3.5 m.y.a. to 32,500 years ago. Even now there has not been enough evidence collected to pinpoint the dates but there appear to have been at least two other times when Beringia was land. It is fairly well established that the American Indian came across this bridge during the period from 40,000 to 20,000 years ago. Some scientists are now trying to prove the date is about 80,000 years ago. The Eskimos and Aleut Indians came over about 13,000 years ago, but were prevented from migrating to the south by extensive ice sheets. There is some thought that they might have come across the Bering Strait by boat. There has been no land connection since about 10,000 years ago.

For several years Dr. William A. Weber, Professor of Natural History at the University of Colorado, has studied the similarity of plants of Siberia with those of Colorado. He has recently returned from a trip to the Altai Mountains with a group of scientists who made further studies.

Although the plate tectonics concept has been accepted by scientists all over the world for only a little over a decade, and there are many areas to be explored further, it is already proving useful in the field of earth and biological sciences.

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New Employees Named

As of May 1, 1979, Denver Botanic Gardens, Inc., has added a new department, that of Director of Development. Robert H. Dodge has been chosen as first director.

Mr. Dodge comes to the Gardens with an impressive record of accomplishment as fund raiser, organizer, and developer for several non-profit organizations in the Denver area. In his work for the Denver Botanic Gardens he will be a development executive responsible for the organization of capital and annual fund raising, planned giving programs, and the preparation of promotional materials and brochures for a development program.

Denver has been his home for 15 years. He is married, with two grown children, is interested in bowling and tennis and he and his wife are both avid gardeners. He is looking forward to his work here because of his love of gardens and because he feels that there is a great potential to be of service.

Mr. Dodge has been active in the Presbyterian Church, in Cub Scout and Boy Scout work, in the Kiwanis Club and its associated youth organization, the Key Club, and in work with programs for retarded children.

Ms. Gayle Weinstein was appointed Botanist-Horticulturist for the Denver Botanic Gardens late in May. She is a native of Denver, a graduate of East High School and the University of Colorado. She also has an MA in Special Education from the University of Denver and an MS in Horticulture from Ohio State University.

Ms. Weinstein has taught in the Aurora, Colorado, Public Schools, in the Denver Public Schools, in the Ohio University School of Agriculture, in the Franklin County, Ohio, training program, and in the Fairfax County, Virginia, Public Schools.

She has been employed in several nurseries, ran her own horticultural consultation service, and worked at the Dawes Arboretum in Newark, Ohio.

She has been responsible for operation and supervision of greenhouses involving production, propagation, and marketing of seasonal, foliage, and bedding plants including associated plant data gathering and recording activities. She has also been responsible for educating secondary, post-secondary, and university students in many areas.

Exotics of COLORADO

Bouncing Bet

Saponarias officinalis

Helen Marsh Zeiner

Once a common garden flower, bouncing Bet or soapwort (*Saponaria officinalis* L.) is often seen growing in large clumps along roadsides and in waste places where it has escaped from cultivation and become naturalized.

Saponaria officinalis is native to Europe and western Asia. European gardeners cultivated this plant for medicinal purposes as well as for its flowers. It was one of the many plants introduced into the United States by early settlers, who often brought with them plants with healing or other useful properties.

A perennial which spreads efficiently by both roots and seeds, soapwort can become a nuisance in the garden. It easily escapes and frequently becomes naturalized. In Colorado it is well

established in dooryards of old abandoned homes, along ditch banks, along roadsides, and in other waste places. It extends into the foothills to about 7500 feet, but is more common at lower altitudes.

Just when *Saponaria officinalis* came to the Denver area is uncertain, but Alice Eastwood reported in 1893 that it was introduced along the D. & R. G. track near Petersburg. It is not listed in Rydberg's *Flora of Colorado*, 1906, or in Coulter and Nelson's *New Manual of Rocky Mountain Botany*, 1909, which would indicate that it was not common at that time.

Bouncing Bet has stout, erect, sparingly branched stems varying from 1 to 2½ feet tall. The stems are usually swollen at the nodes, a characteristic of the pink family, Caryophyllaceae, to which this plant belongs. The leaves are opposite, simple and entire, 2 to 3 inches long, ovate-lanceolate in shape, and strongly 3-nerved.

Dr. Zeiner is the Honorary Curator of the Denver Botanic Gardens Herbarium. She is also on the Editorial Committee for *The Green Thumb*. Her column "Exotics of Colorado" has appeared for years in the pages of the magazine.

The leaves and roots of *Saponaria officinalis* have a mucilaginous juice containing saponins which will form a lather with water. This soapy lather has been used since mediaeval times to remove greasy spots from clothes.

Saponaria officinalis was valued from ancient times for its curative powers. Mediaeval Arab physicians are said to have prescribed the plant for leprosy and various skin ailments including itch. Extracts from the leaves were used to increase perspiration to relieve rheumatism and gout. A liquid from macerated roots was used to ease inflamed mucuous membranes, particularly of the respiratory and gastrointestinal tracts. The plant also has a mild purgative action.

The name *Saponaria officinalis* reflects the medicinal uses of this plant. *Saponaria* is from the Latin *sapo* meaning soap and refers to the lathering properties of the leaves and roots. *Officinalis* is from the Latin *officina*, a work shop. Medicinal plants were kept in stock by apothecary shops and the pharmaceutical meaning of *officinalis* came to be "of drugs".

Bouncing Bet is a fanciful name of uncertain origin. Soapwort refers to the lathering properties of the leaves.

Many familiar plants are related to *Saponaria*. Pinks, carnations, and baby's breath are well-known garden relatives. Native plants include common chickweed and campion. *Paronychia* or nailwort and sandwort or *Arenaria* are relatives growing at high altitudes.



Saponaria officinalis

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Grasses Suited to Colorado Lawns

Jack D. Butler

In spite of diverse climatic conditions and the fact that many grasses are found naturally in Colorado, few seem to be well adapted for home lawn use. Whether a lawn is located in the warmer southeastern part of the state or at 10,000 feet elevation, the same lawn grasses are commonly used.

Whether or not a grass performs satisfactorily for a lawn depends upon several factors. The quality of turf desired and its potential use — for heavy play, for erosion control only, etc. — are important considerations in choosing a suitable lawn grass. Thus, the questions arise — will a natural type lawn serve, or is one of high or moderately high quality desired?

Of particular concern in selecting grasses for lawns is the availability of adequate water to keep the quantity and quality desired. Of less concern generally, but of major concern to those experiencing the problem, is with water and soil that contain appreciable levels of soluble salts. Rocky, droughty, and other adverse soil conditions can also be quite important in selecting suitable grasses for lawns.

Dr. Butler is a specialist in grasses and sods at the Colorado State University in Fort Collins, where he is a member of the teaching staff.

With the above in mind, a brief discussion of some of the more common grasses available, and sometimes used, for home lawns is in order.

Kentucky bluegrass is the "lawn grass" of Colorado. Wherever a person goes in the state there are Kentucky bluegrass lawns, and this grass deserves some, perhaps much, of the credit given to the state for its fine lawns. Kentucky bluegrass, although found growing widely throughout Colorado without supplemental water, requires irrigation to produce a good quality lawn, and on most sites, irrigation is needed for it even to stay alive. One of the more desirable traits of Kentucky bluegrass is that it is a cool season grass — it remains green throughout most of the year.

Kentucky bluegrass is intolerant of even moderate soil salt levels. Where salt causes a problem for Kentucky bluegrass, other cool season lawn grasses such as perennial ryegrass, fine fescue, and alkaligrass may perform satisfactorily.

There are many different cultivars of Kentucky bluegrass available to those establishing new lawns. Presently there are more than 60 different commercial Kentucky bluegrasses under test at

Colorado State University. Many of these are outstanding and do quite well when planted alone. However, the trend with Kentucky bluegrass is to blend of two or more of the cultivars, for example — Baron, Adelphi, Merion, and Glade. Blends are generally available as sod or seed. Blending cultivars allows for the strengths of various cultivars — Glade does rather well in the shade and could be expected to persist where tree or structural shade causes a problem, and Merion, which performs poorly in the shade, has demonstrated fairly good drought resistance to help counter environmental problems.

Presently there is a limited amount of work underway to develop more drought tolerant Kentucky bluegrasses. It is to be hoped that in the not too distant future, Kentucky bluegrass cultivars developed specifically for Colorado conditions will be available.

Perennial ryegrass, because of the introduction of many good quality turf-type cultivars, has taken on increased importance as a lawn grass. These ryegrasses have a rather good tolerance to moderately high salt levels. The perennial ryegrasses are bunch grasses, and have not shown as good a cold temperature hardiness as Kentucky bluegrass and fine fescue. Rather than to plant the perennial ryegrass as a pure planting, the practice is to mix one or more turf-type ryegrasses with Kentucky bluegrass and fine fescue. However, because of the fast germination and aggressive nature — tendency to crowd out other grasses planted with it — of the ryegrasses, the percent in the mix is usually kept at 25% or below.

There are many different commercially available cultivars of perennial ryegrasses. It is not possible to list all of the cultivars here, but a few that are commonly available and perform well are Citation, Derby, Manhattan, and Pennfine.

Fine fescues (Chewings, Creeping red) have very narrow leaf blades, thus the name. Fine fescues often perform exceptionally well, with adequate irrigation, on sandy soils and other areas that drain well. Except for fairly dry, shady areas where fine fescues normally perform well, they are mixed with Kentucky bluegrass. There are numerous cultivars of fine fescues commercially available as seed — for mixing, packaged as a commercial pre-mix, or for straight planting.

Two cultivars of fine fescue, Golfrond and Dawson, have performed rather well at fairly high salt levels. A few of the other cultivars that are rather widely available are Fortress, Highlight, Jamestown, Pennlawn, and Ruby.

Tall fescue is a coarse leaved bunch grass often found as a weed in Kentucky bluegrass lawns. This deep rooted grass is, in the eastern U.S., noted for drought tolerance; also it performs rather well at moderately high salt levels. In much of Colorado it does rather well with infrequent waterings that soak deep into the soil. Tall fescue is seeded at a heavy (5 or 6 pounds per 1000 sq. ft.) rate so that a dense stand and finer texture is achieved. Tall fescue is not used for home lawns, to any extent, in Colorado; however, it has a good potential for use in the state, especially in the southeastern areas and at lower elevations in western Colorado. In areas that are to receive infrequent irrigation, and at higher elevations, it is sometimes mixed with other coarse grasses for erosion control and natural type plantings. Three of the cultivars grown in Colorado are Fawn, Alta, and Kentucky 31. Research is being directed toward the development of finer textured and strong sod forming tall fescues.

Buffalograss is an important grass for unirrigated home lawns in the high



Sod Test Plots at the Denver Botanic Gardens

plains. Buffalo is a warm-season grass — green only during the warmer time of the year, and it is very shade intolerant. Irrigation can be beneficial in establishing stands, but generally watering, unless very carefully done, will cause it to be replaced by cool season grasses. Buffalograss, in pure stands, under certain climatic and soil conditions may not require mowing; however, it will withstand frequent and close mowing. Mowing is a useful tool for keeping

competition from taller growing grasses and forbs in check. It needs little, if any, supplemental fertilizer for satisfactory growth.

Buffalograss may be propagated vegetatively (sod pieces) or with seed. Most of this grass grown in Colorado is now started from seed (treated seed is preferred). Seeding rates range from 1 to 3 pounds per 1000 square feet, and even higher rates may be used to speed



the rate of cover. Cultivars of buffalograss grown as lawns in Colorado include common buffalograss and Sharp's Improved.

Blue grama is another warm season grass often found associated with, or mixed with buffalograss for use in non-irrigated plantings. Blue grama produces short rhizomes (underground stems) that can produce a fairly dense turf. Its open and somewhat bunchy growth does not have enough density to form a really smooth turf. Required maintenance is rather similar to that of buffalograss.

Bermudagrass and Japanese lawngrass (*Zoysia japonica* Steud.) are two warm season grasses found occasionally in Colorado lawns. Although common bermudagrass is found widely in northern Colorado, the hardiness of the elite turf types anywhere in the state is questionable. Bermudagrass found in cool, dry areas is normally coarse and stemmy and produces an open, low-density turf. Bermudagrass exhibits exceptionally good drought and salt tolerance. Bermuda can be quite weedy in nature, and in areas of adaptation — southeastern Colorado — often escapes to become a serious weed in Kentucky bluegrass lawns.

Meyer (Z-52) zoysia can produce a dense, tough grass. In areas of the state with a long growing season this grass may perform satisfactorily. However, two factors — short period of greenness and slow ground cover from plugs — become important considerations in deciding whether or not to plant this grass.

Fairway wheatgrass is an introduced, coarse textured, cool-season grass used occasionally for lawns in Colorado. With adequate water this grass can produce a presentable turf. Young stands of this grass are not especially drought

tolerant. Without adequate water it will tend to bunch up; however, it needs only infrequent watering to remain green.

Smooth brome is a coarse-textured, strongly rhizomatous, cool-season grass introduced from Europe. Smooth brome is found widely under dry conditions and at high altitudes. Smooth brome remains green through extended periods of drought. It may be planted as pure stands, and it is a frequent component of mixtures with other coarse grasses. Smooth brome grows quite tall; however, under many growing conditions, it will tolerate a rather low mowing height. Investigations are underway to improve the density and texture of this grass for turf uses.

Several other grasses, not yet mentioned, are available for natural type plantings. These may be planted alone, but the practice of mixing them with some other grasses is common. Intermediate, pubescent, crested, and western wheatgrass are some of the wheatgrasses used. Side-oats grama, sand lovegrass, green needlegrass, and little bluestem are other grasses sometimes found in commercial mixtures for revegetation or natural type plantings. These mixtures are available under various trade names that denote area of adaptation, purpose for planting, etc. These names can be helpful in making a selection of a mixture for a specific site.

From the above discussion it is evident that there are several grasses that might be used for Colorado lawns. But their suitability, because of various characteristics and requirements, especially for a good quality home lawn, is often questionable. Unless a person has definite reasons it is usually well not to deviate greatly from lawn grasses that have proven suitable in the past.

The Year of the Rose



Joan Franson

The rose more than any other flower has been closely entwined in man's history for thousands of years. No united effort has been made to declare it for what it is — the favorite flower of the people. 1979 was chosen by a newly formed Rose Council to be the "Year of the Rose" and it is a salute to the rose — the living symbol of love, friendship, and peace.

Pictorial evidence in paintings and on porcelain designs shows that roses were cultivated in China thousands of years before Christ. Since then men and roses have been companions

through legends, music, poems, art and religious rituals.

For the first time fifteen divergent horticultural organizations have been united for one purpose — a cooperative campaign to publicize the rose by all means available to them. These organizations are listed as sponsors with five groups serving as the steering committee for the campaign. Those serving on the Rose Council are: All-American Rose Selections, American Association of Nurserymen, American Rose Society, Roses, Incorporated, and Society of American Florists. The balance of the Sponsors are: American Horticulture Society, Garden Centers of America, Home and Garden Supply Merchandiser, Mailorder Association of Nurserymen, Men's Garden Clubs of America, National Association of Plant Patent Owners, Inc., National Landscape Association, National Lawn and Garden Distributors, Inc., Ohio Association of Garden Clubs, Inc., and Wholesale Nursery Growers of America.

Mrs. Joan Franson is well qualified to write about roses. She is Rocky Mountain District Director for the American Rose Society, an Accredited Rose Judge, and a Consulting Rosarian for the Society. Her district covers Colorado, Utah, Montana, Wyoming, and part of Idaho. She has been an active Volunteer for the Denver Botanic Gardens since coming here in 1960 and is at present Vice-president of the Associates. She has been on the Board of Trustees in her capacity as president of Around the Seasons Club and will again be on the Board in the fall when she becomes president of the Associates.

Why was the rose chosen? It is the favorite flower of most people in the United States. One statistical proof recently offered was the results of a carefully authenticated poll taken of their customers by the over 15,000 Retail Telegraph Delivery florists. The popular rose received first place with 126,253 votes while the nearest competitor, the carnation, had only 39,077 votes.

This is the 40th year the All-American Rose Selections has been testing roses before they are put on the commercial market. Over the years a few great roses have been overlooked and a few mediocre roses have been awarded the AARS designation. But on the whole, a beginner will stand a better chance of choosing quality performing roses when he tries the AARS roses. In this program of testing, roses are graded and records are kept in 25 gardens spaced across the United States. Those varieties with the best over-all scores are considered to determine which roses (if any) will win the coveted AARS tag each year. Certainly some winning roses will do better in one part of the country than another. However, these tests have weeded out many poorly performing roses before it became their fate to be introduced into commerce.

From the least worldly of people to those most sophisticated, roses have ever won a response in the hearts of humans. Tensions and daily cares are eased when you work with roses in the sun and fresh air. This Queen of Flowers reaches into troubled thoughts and brings a peace that is needed more than ever before in our hectic day-to-day pace.

Plant some roses! Do not hesitate because you are afraid that rose culture

is too complicated. A plant which has fossil proof of living dating back 40,000,000 years ago in Florissant, Colorado has got to be a very tough plant. And certain roses bloom on each year in states of healthy neglect just as prettily as the most pampered bush which is hovered over by a dedicated rosarian.

Roses are available to people both as plants and as cut flowers. By stimulating interest in roses, more people will be encouraged to go to gardens, flower shops, garden centers, and nursery catalogs. Here their renewed involvement with roses can be coupled with plants and flowers of all types. All phases of gardening will benefit when once the spark of interest in roses brings people into contact with plants and nature.

In addition to paying long overdue homage to the rose, the basic purpose of the campaign is to stimulate increased public interest in roses and indeed in all flowers and gardening. It is hoped that more space in newspapers and periodicals will be devoted to roses and gardening instead of being filled with items on murders, scandals, and travel.



Hybrid Tea Rose

The commercial organizations sponsoring this campaign will ask their members to offer special "Year of the Rose" plant collections or flower offers and merchandise throughout 1979.

The All-American Rose Selections has helped assemble a kit (weighing over $\frac{3}{4}$ pound) for the Year of the Rose. Each participant who has information in this kit printed up his own material which was assembled and mailed by AARS. Pamphlets in the kit cover such subjects as how to care for florist roses, how to plant rose bushes, the proper method to cut roses for longer life in arrangements, publicity items, information on the AARS test gardens, ideas on where to plant roses

in home landscapes, legends and myths about the rose, ideas for rose societies to promote roses, information on joining the American Rose Society, and also a large colorful poster on the "Year of the Rose — 1979". This kit was not publicized but over 9,000 such kits were mailed at the last count. Requests have begun coming in from other countries and now it looks like the Year of the Rose Campaign will be going international.

What power the beauty of the rose has for man! Whether it is a five petaled variety, compelling in its simplicity, or a high centered, fully double modern hybrid tea, the rose reigns now as before — Queen of Flowers.

Botanic Gardens Delegates to Meet in Denver

Delegates from all over the United States will converge on Denver July 8 to 14 for the annual convention of the American Association of Botanic Gardens and Arboreta. Between 150 and 200 persons are expected to attend. Denver Botanic Gardens will be host to the gathering and the committee in charge has planned a varied program of business and pleasure for the meeting.

A pre-conference tour is arranged for Monday, July 9 for a study tour of Rocky Mountain National Park with an overnight stay at Grand Lake. The visitors will travel by bus for this tour and for a second one planned for a half day trip to Mt. Goliath. Trips are also planned for points of interest around Denver and for the Denver Botanic Gardens.

The business sessions will cover many things of interest to botanic gardens personnel. Included are such topics as budgets, fund raising, how to attract visitors, financial planning, use of native plant material, and others. The visitors will be housed at Colorado Women's College.

A post-conference tour will take the group to the U.S.D.A. seed storage laboratory at Fort Collins.

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Saxifrages For Local Gardens

Panayoti Peter Callas

- 66 For lovers of mountain wildflowers, members of the genus *Saxifraga*, like primroses or gentians, are something of a Holy Grail. These "rock breakers" as their Latin name suggests usually favor the craggy heights of mountain ranges throughout the northern hemisphere, but divergent races have evolved a bewildering profusion of species and forms that occupy myriad habitats from bog and woodland to scree in all north temperate regions. In our own mountains saxifrages assume such a variety of guises that the credulity of amateurs is always being tried. How can the ubiquitous brook saxifrage (*Saxifraga odontoloma* Piper) that fringes every subalpine freshet with its scalloped, glossy green leaves be related to the tiny gold saxifrage (*S. serpyllifolia* Pursh ssp. *chrysantha* (Gray) W. A. Weber) which haunts the very summits of the Colorado Rockies? The former dangles airy sprays of tiny white flowers on stems half a meter long, while the golden saxifrage hoists comparatively giant 2 cm flowers on stems barely 5 cm tall.

Everyone grows roses, annuals, or iris. Few gardeners realize that sturdy garden strains of saxifrage exist, even of some of the most condensed and showy alpines. For the adventurous gardener who attempts to come to terms with this protean genus, how can he take stock and select a few plants that can recreate some of the magic of the mountains in a corner of his garden? There are other perils in the way, since the genus contains many dowdy and inconspicuous species while others resolutely refuse to descend from their arctic homes. Most gardeners may not be willing to expend the needed effort to find out about these plants, locate sources, and finally grow them; but for the gardener who prizes elegance of form and delicacy of flower instead of just bulk and mass, few plants can provide greater year-around interest than the saxifrage.

Almost all garden saxifrages are Eurasian. Many are unselected wildflowers that will adapt with ease to garden conditions, but most garden saxifrages are either natural or artificial hybrids that have been selected over the decades for their form, flower-size, or ease of cultivation. A typical instance of this process is exemplified by the *Bergenias*, which have often been included in the genus *Saxifraga* in the past and still are offered as saxifrages by many nurserymen.

Panayoti Peter Callis has been a teacher in Boulder. He is active in the Rock Garden Society and the Colorado Native Plant Society. He has written a number of articles for *The Green Thumb* in the past several years.

These are the most frequently featured saxifrages in conventional gardens because of their wide tolerance of different soils, exposures, and their unquestioned garden merit. Unfortunately their effect is far more tropical than alpine, forming as they do lax rosettes of huge, scalloped, spoon-shaped leaves that can exceed a foot in length and 6 inches in breadth. These leaves are the chief appeal of the *Bergenias*, for they are of a heavy, leathery, evergreen texture. The growing point of a slowly ramifying rhizome sprouts fat buds early in the spring that slowly develop into a stocky, loose raceme of pink stars an inch or so across on thick stems a foot tall. The effect is interesting, if not exactly brilliant.

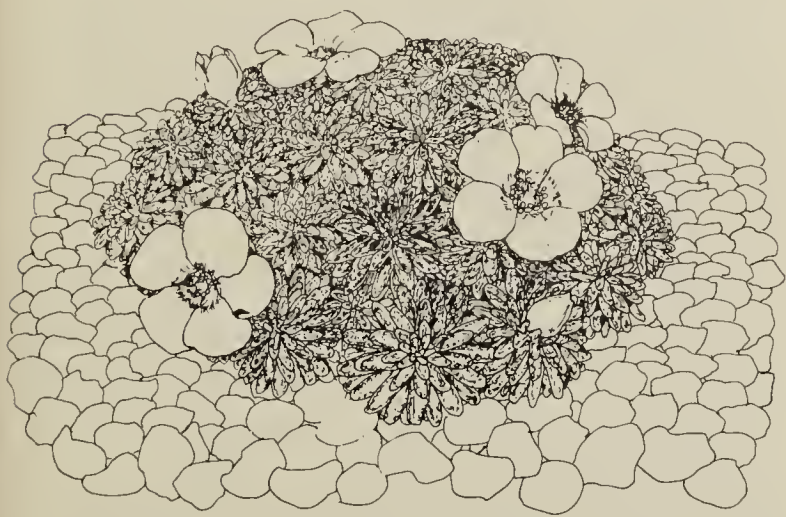
Garden *Bergenias*

Garden *Bergenias* are a mixed race, derived from upwards of half a dozen species introduced to cultivation from Siberia and the mountains of Central Asia within the last century. Considering their provenance, it comes as no surprise that these stalwart plants have proven durable in our climate

over a period of decades. The broad leaves are often sun or wind burned by late spring in our variable climate — but this hardly seems to affect the health of these indestructible plants.

It is a pity that the best known saxifrage in our gardens should be such an exotic, lush plant as the *Bergenia*, for the appeal of the rest of the genus is quite different. The saxifrages that most frequently appear in private and botanic gardens throughout Europe are plants with refined, variable foliage and a fragility of blossom that belies their alpine origin. They are all cold climate plants that quickly languish in subtropical climates. Surprisingly, a number of the most alpine of Eurasian saxifrages have proven amenable to cultivation — even in the mild, maritime conditions of England or the Pacific Northwest. Local gardeners have discovered that, given some care in soil preparation and care in planting, many of these same species are proving easy garden plants in Colorado, while other species that are deemed difficult plants in lowland gardens seem to enjoy the crisp air and cold winters that we take for granted in Colorado. Of course, these mountain saxifrages are not plants for borders. Neither do they make much of a show if they are used as edgings to formal beds. These are informal plants whose flowering season is a brief and sometimes spectacular climax to a year of constant and quiet interest.

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Saxifraga 'Cranbourne'

When the rest of the garden is being put to sleep, the roses muffled, and the trees mute, a bed of saxifrage is still a living arabesque of lively textures and subtle colors. Children and pensioners are the first to notice saxifrage, but anyone with an hour to spare and any imagination can enjoy the endless variation in form and flower displayed in a thoughtful planting.

68 Colorado Rock Breakers

What are the "Rock Breakers" that we can use in a Colorado garden, and how do you grow them? Out of the hundreds of species available to gardeners, which will adapt best to our gardens? As is the case with any genus of such a size, the species group themselves into certain natural aggregates that differ somewhat in cultural requirements from group to group. In general, it is important to remember that saxifrages are found among rocks in the wild, in areas where moisture drains promptly from the surface of the soil, but lingers in the crevices and under rocks where the plants extend their roots. They prefer soils that are rather lean in nutrients but rich in humus and rock chips. Ordinary garden loam mixed with equal parts humus and quarter inch or smaller rock chips will provide an ideal growing medium for most of the members of the genus.

Because our Great Plains' sun is so much hotter than at the blustery heights of the mountains, watering a bed of saxifrages can be minimized if they are placed to

the north of a rock, or with the distant shade of a building or obstruction cooling them during the hottest parts of the day. Few plants will tolerate hungry tree roots for long, or the choking glut of leaves that trees shed in the fall. Woodland saxifrages will tolerate the open shade of trees overhead, but the alpines of the genus like a site open to the sky where they are free from too much crowding by other plants. A raised bed five or six feet across, with sloping ground, composed of the soil mixture described above, livened with a few unobtrusive rocks is an ideal setting for these plants. If the soil that was used to construct a more traditional rock garden is sufficiently porous and rich — and not overgrown by noxious weeds such as *Campanula rapunculoides* L. — there is no better way to grow a saxifrage than nestled in the crevices of such a garden.

For gardening purposes, saxifrages are divided into four groups. The Mossies and Miscellaneous groups are primarily woodland plants in nature that respond to more shade and moisture than their more alpine relatives. Members of both these groups are widespread in both Eurasia and America. The Silver or Encrusted Saxifrages extend from the Pyrenees to the Caucasus in nature, with a few outlying populations in eastern Canada. The last group comprises the bewildering confusion of the *Kabschias* — which include the closely related *Englerias* — and their multifarious offspring. These, too, are alpine developments — often densely pulvinate (forming tight cushions). They are among the showiest of tiny rosetted alpine plants.

Mossy Saxifrages

The Mossy saxifrages are rather frequently encountered in gardens, for they are decorative in both leaf and blossom. There are dozens of species in the section *Dactyloides* from which the garden races derive, few of which are widely grown in their own right. The southern Rockies even boast a local form of the circumboreal species *Saxifraga caespitosa* L., which is one of the purported parents of the garden plants. Our native species does indeed resemble the garden forms, all its parts however are reduced to a third or less the size of the typical Mossies. Neither is it the least bit amenable in the garden. Mossy saxifrages have copiously forking, prostrate stems that produce dozens of sticky, fork-leaved rosettes of a flimsier texture than other saxi-



Saxifrage — *Engleria* type

frages. These are, however, decorative the year around and quickly form large mats a foot or more across that superficially resemble a giant bed of moss. The flowers soon dispel the illusion, for these are large and showy, produced in abundance in late May on stems 6 or 8 inches tall. The five petals can be white, creamy, or variable shades of pink and garnet that are unusual in the wild Mossies.

Freshly opened buds of the latter shades are quite deeply colored, while older flowers on the same stem and plant quickly fade to a duller pink. Mossies like steep banks of humus to grow on, loving to clamber slowly over rocks. Although they are rather short lived compared to their cousins, the Mossies self-sow quite liberally and are easily struck from cuttings so that when a plant begins to show die back after 5 or 6 years, it is easy to replace it.

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Miscellaneous Saxifrages

Miscellaneous saxifrages are a motley crew of plants that doesn't fit into the larger conglomerations within the genus. Although hundreds of species in the genus qualify in this category, relatively few of these have survived the trauma of introduction to gardens.

Saxifraga oppositifolia L. is a notable exception. The Purple Saxifrage has proven one of the most adaptable of high alpine plants in gardens where its modest demands are met. Few plants have a wider distribution in nature — abounding on alpine scree and fell field throughout Eurasia and America, extending as far south as the Northern Rockies and Cascades. There is surprisingly little variation in this plant, considering its range. It produces long, prostrate shoots clothed thickly with imbricated, deep green, opposite leaves that are sometimes fringed with tiny hairs. These shoots overlap and form a dense, prostrate mat that covers itself in time with comparatively huge purple flowers. A

gem of the genus, this is nonetheless left to gardeners who are willing to provide it with the cool, open exposure it requires in a soil enriched with rock chips and top dressed with gravel where it will never dry out completely. Situated properly, it spreads surprisingly quickly for such a bona fide alpine.

70 Other frequently encountered saxifrages include a number of woodlanders. The Strawberry Begonia (*Saxifraga stolonifera* Meerb.) is, of course, neither a strawberry nor a begonia. Aside from gracing millions of homes, this vigorous houseplant can be found in one of its many forms through forests in East Asia. The more variegated the leaf, the less hardy the plant, according to many growers. I haven't found this to be the case, necessarily, since an especially broad-leaved, variegated form has proven to be the most durable and vigorous in my garden. These plants really enjoy growing outside, provided they are given the shade and moisture they require. Here you are more apt to see the foot tall spires of fascinating flowers than in a stuffy parlor. Like many stoloniferous plants, they really resent being confined and will quickly root their long runners among ferns and primulas. These will in turn put down roots and send out stolons. The flowers are usually produced in the summer on wiry stems, peculiar two or three petaled, lopsided blossoms that are distinctly ornamental. People are continually surprised to discover that this favorite house-

plant is actually a hardy wildflower.

The London Prides (*S. x urbium* D. A. Webb) comprise a large group of shade-loving succulent saxifrages that are quite popular in Europe but almost unknown in America. The prevalent hybrid together with its wild parents has been grown for centuries in cottage gardens where their form, resembling a large, green-leaved sedum, has been prized for filling shady nooks. In small gardens, the microform *S. urbium* var. *primuloides*, is less invasive and more decorative. These would remain neat, compact, and floriferous in the sort of spot now relegated to leggy, sun-starved sedums.

Silver Saxifrages

It is something of a relief to leave these variable woodland saxifrages for the turfy boulder fields where the Silver Saxifrages reign supreme. These Silvers are well known in many Colorado rock gardens. They have been sold for years at the Botanic Gardens Plant Sale where they always excite interest, and it is not unheard of to find a pot of two of svelte Silver Saxifrage sitting among the plump sempervivums in local nurseries. They do indeed look rather like embroidered sempervivums: their tight rosettes are thickly encrusted with limy deposits along the margins of the flat, leathery leaves. This silver encrustation is responsible for both of the better known common names applied to this race. Although most species of Silver, or Encrusted Saxifrage are rather local plants in nature, restricted moreover to certain rock substrates, most of this group is thoroughly adaptable to gardens. If

they often share crevices with sempervivums in the Alps, don't suppose that they can be treated quite the same way in the garden. Saxifrages do not like to have their roots desiccated and unnecessarily disturbed. They will never put up with the abuse the Hens and Chickens seem to thrive on.

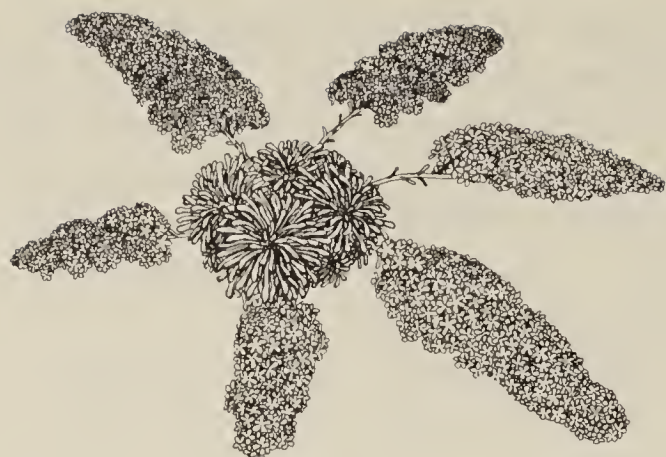
Placed on a slope or among rocks, with a decent garden loam, kept from being overly cultivated or smothered by neighbors, protected from being either drowned or scalded, a tuft of Silver Saxifrage will quickly build up into a showy mound of silvery rosettes that annually send up a constantly expanding forest of stems in late Spring. The flowers are from a centimeter to two in width — not showy in themselves — but produced in such profusion that few plants can equal their airy grace at blooming time. Seed generally sets heavily in this group; by midsummer the branched wands of the Silvers begin to open their swollen, upright capsules. Each pod contains dozens of tiny black seeds that germinate readily and often self sow. The seedlings cannot be depended upon to resemble their parents — especially if several sorts are grown in proximity — but these seedlings are just as interesting in their new combinations.

Silvers can vary from huddled masses with each individual rosette less than a centimeter across, to giant starfish over a foot across. Just one species, *Saxifraga paniculata* Mill. (*S. aizoon* Jacq.) can encompass this broad range of characteristics in its variable manifestation throughout the Alps. Typical *S. paniculata* — the most widespread form of all the Silvers, forms incurved rosettes an inch or

two across. The flowers are more creamy in color than other species, or sometimes pink-flushed or yellow. A large form of this species has been selected with rosettes 5 or more inches across, otherwise like the type, with wands correspondingly longer. The loveliest form is probably *S. paniculata* v. *minutissima*, which has been found in several areas in the wild. It even predominates in a few restricted areas of the Italian Alps. Here the rosettes are heavily sil-
vered, barely a centimeter across or smaller. They spread rapidly across the surface of the ground, producing stems 3 or 4 inches tall sporting flowers large for the size of the plant. Because it is so tiny, this form deserves the special treatment outlined under the *Kabschias*.

Rare Silvers

Saxifraga cochlearis Rchb. and the rare *S. valdensis* DC are two other tiny Silver species with restricted ranges in the wild. The latter is regarded as a difficult plant to grow. It is attempted only in alpine houses where excess moisture can be kept from rotting it. The former is far more manageable in the garden; it is in fact one of the treasures of the genus. The huddled rosettes of *S. cochlearis* are composed of fatter leaves than most Silvers that end in a sort of nobby protuberance at their tips which is diagnostic. This form is usually encountered in one of its smaller manifestations that are usually designated as the variety *minor*, with rosettes less than an inch in width. Even young colonies of this plant present a hoary, weather-worn appearance, for *S.*



Saxifraga callosa

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cochlearis grows almost as tall as broad, resembling an animated stone. The flowers are a rather unexpected dividend, since no one expects much beauty from such a plant. These are among the loveliest flowers among alpinists, produced on wiry stems much finer than in the other Silvers, 6 or 8 inches in height. The five petals are rather longer and a more dazzling white than is usually encountered in the genus. Unfortunately, although it sets seed with ease, it will cross pollinate with any other Silver in the garden. It deserves the time and care it requires to obtain and grow true seed to maturity, for this choice species is rather more difficult to strike from cuttings than its relations.

S. hostii Tausch. and *S. callosa* Sm. are rarely encountered in their true forms in American gardens. These are variations on the theme presented by *S. paniculata*, although both have whiter flowers than that common species and the foliage is quite distinct. The chubby rosettes of the former are rather more silvery and less incurved than *S. paniculata*, forming denser colonies, while *S. callosa*, long known by the name of *S. lingulata* Bell. in gardens is even more distinct. Here the rosettes are larger and more spi-

dery than most other species. The leaves can be 6 inches long and less than a quarter inch wide, the margins heavily encrusted with lime. The flower stalks are produced in lopsided sprays that arch to the side of the rosettes rather than forming an upright candelabrum as is customary in the section.

This striking species forms a bridge of sorts to *Saxifraga longifolia* Lapeyr., one of the gems of the rock garden. This Pyrenean endemic is a favorite of photographers, forming as it does extremely symmetrical rosettes of narrow, overlapping leaves that splay against the vertical cliffs in the Pyrenees. When after many years this plant has built up the strength to bloom, it shoots out a massive flower stalk a meter or more in length producing hundreds of white stars of bloom. The wild plant is unique among the Silvers in being monocarpic; that is, the plant itself dies after blooming. It rarely produces offsets in the wild or in the garden unless it has been diluted by other species. As a consequence, few except alpine gardeners have the energy to keep a stock of this startling plant coming from seed. Lazier gardeners can enjoy a number of hybrids that have been produced which approximate the grandeur of the wild plant while producing offsets to repeat the performance in succeeding years.

Few plants could be discussed in the same breath with this and not appear a trifle anticlimatic, but *S. cotyledon* L. is just as showy as *S. longifolia* in its own way. This species occurs throughout the European mountains, even cropping up in Labrador, in a profusion of forms — all of which produce equally massive flower

stalks. The individual rosettes can form giant cartwheels a foot across composed of broad, flattish leaves over an inch in width. In this species too, they are heavily bordered with lime deposits and are never more striking than in the winter when they take on rose and purple tints. In some forms the inflorescence branches from the base; in others there is a distinct stalk. All produce offsets every season that can easily be struck from cuttings. Because of its massive size, this saxifrage requires careful placement in the rock garden. Since it too is primarily a crevice plant it is best placed high on a steep slope or between rocks to ensure quick drainage and also to show off the humped rosettes and giant wands of blossom. If the placement of this saxifrage is tricky aesthetically, it is typical of its section in being widely adaptable to a variety of soils and exposures in the garden. It will thrive anywhere that's well drained and neither dank nor parched. All of the Silver Saxifrages will respond to this ordinary garden condition, but their distinctive forms seem to suggest a more careful placement than is usually accorded perennials. They deserve to be set away from more gaudily flowered annuals and perennials in a special bed that will not be constantly harried with cultivation, where the slowly spreading mats of each plant can blend into one another in a naturalistic fashion. In such a setting, the silvered patterns of their evergreen rosettes are decorative year around, never more valuable than in the flowerless depths of winter.

***Kabschia* Saxifrages**

Kabschias are special plants. They require more care and forethought in selecting their site and planting than most gardeners can provide.

They are not large, the flowers are not overwhelming — taken individually — but no plants can give the gardener more permanent or evocative pleasure. For *Kabschias* are high alpine plants. Not only do the species in this section come from the highest mountains of Eurasia, but they seem to transport some of the grandeur of their habitat to the garden. They are one and all cushion plants composed of tiny, spiny rosettes that come in a variety of colors, forms and textures. The flowers are produced on low stems, rarely more than 3 inches in length. They are large for the size of the plant, of a translucent texture and a broad range of colors, often produced so thickly as to completely conceal the body of the plant. Anyone who loves the floriferous fell fields of the tundra will be captivated by *Kabschias*.

How can these be grown here? in maritime climates, *Kabschias* are usually grown in alpine houses where they are safe from the constant alternation between cold and wet spells. They often begin growing during mild spells in the winter, when their tender growth is more susceptible to damage and rot than it is in colder, dry climates like Colorado where they are soundly dormant from November until March. The first begin to bloom in March, and the season sometimes extends through May. In order to grow successfully, they should be grown on sloping ground, which ensures perfect drainage. Their soil should be loose — a good loam enriched with abundant sand, stone chips, and humus that will never waterlog in cloudbursts nor dry out completely

74 in droughts. Although many *Kabschias* will tolerate full sun in cloudy climates, all prefer a cooler aspect in Colorado — a northern aspect is ideal so long as it is not densely shaded or clammy. Sun for part of the day insures that the tight domes of these plants stay compact and characteristically alpine. In a carefully chosen spot such as this they will not be as subject to desiccation, requiring minimal maintenance. Watering should be entirely withheld throughout the winter months in most years, but during our more mild, chinook-ridden winters, occasional sprinkling on warm days may still be necessary. They should never become sodden during this season, for *Kabschias* enjoy the long winter rest provided by our climate.

If all saxifrages seem to enjoy top-dressing with pebbles, a half inch or so mulch of pea-gravel is almost a necessity with the *Kabschias*. This mulch discourages slugs and insects, helps cool the soil in summer and prevents deep frosts in winter. It also inhibits the growth of moss and weeds and mimics the shingly scree slopes where these plants grow best in nature.

Given these conditions, *Kabschias* will grow lustily and live to a great age in our gardens. The slowly spreading mounds are a joy at all seasons, but never more so than when they are covered with giant, nickel-sized flowers. The variety of *Kabschias* available to gardeners is awesome — several hundred cultivars are available in the trade. No group of essentially

alpine plants has ever been more thoroughly and satisfactorily improved by the hybridizer's art. The several dozen wild species of *Kabschias* are lovely plants in their own right — only the European species are widely cultivated at the present time — but like most wildlings, they take unkindly to garden conditions. Garden-worthy strains of many *Kabschias* have been evolved over the years, primarily of European species, although *Saxifraga lilacina* Duthie from the Himalayas is also in commerce.

This is one of the tiniest plants in cultivation. Individual rosettes are barely an eighth of an inch across — dwarfed by its own inch wide flowers. It is one of the more difficult *Kabschias* to grow — requiring a cooler exposure than most with even better than average drainage. It is nonetheless tamable, growing into an incredibly dense little bun that resembles nothing more than a lichen.

Kabschia Hybrids

For the beginning *Kabschia* enthusiast, the hybrid *Kabschias* are the most easily accommodated. Most of the hybrids using *S. lilacina* as one parent are surprisingly easy to grow, and their lavender or pink flowers are especially attractive. *S. x Myra* was the first of these hybrids to be produced and still one of the best. Reginald Farrer, the father of the English Rock Garden, produced this plant at his nursery in Yorkshire, and since that time many more purple saxifrages have been added to gardens. Others include *S. x Cranbourne*, *S. x Riverslea*, *S. x arcovalleyi* Sunderm.

The sturdiest garden *Kabschias* are usually yellow or cream colored. Many of these are also fifty or more years old in gardens, the best of which are *S. x apiculata* Engl., *S. x haagii* Sunderm., *S. x elizabethae* Sunderm. and *S. x apiculata alba*. These all grow at a surprisingly quick rate, quickly forming broad, tight mats that will produce a wealth of blossom in April. All of these have thrived for many years in Colorado gardens.

Among the species, none is showier than *S. burserana* L. This is a widely distributed plant in the eastern Alps that occurs in a variety of forms. Typically, it is a densely mounded bun of gray, spiny rosettes that grows slowly and deliberately in the garden. It seems to need more limestone in the soil than other species in order to retain a healthy blue green color or flower properly. When it does bloom, the quarter-sized flowers are of the purest white. Forms selected for size or delicacy of flower include *S. burserana* cv. *crenulata*, *S.b.* cv. *tridentina*, *S.b.* cv. *magna*. A mulch of limestone chips can help to keep this choice plant in good health.

Other European *Kabschia* species that adapt well to gardens include the many forms of *S. marginata* Sterno., *S. scardica* Grisbe. and *S. ferdinandi coburgi* Kellerer and Sunderm. These and other species are not always floriferous in the garden, however, but a challenge because of this to ambitious gardeners.

One last, large section of *Kabschias* remains to be mentioned. The *Engleria* saxifrages hybridize readily with the more typical,

large flowered *Kabschias*, and are therefore often lumped with them. Their appeal is altogether different, however, for the *Englerias* are altogether larger, more sculpturesque plants that have much larger rosettes and tall, stately flower stalks. The flowers are rather inconspicuous and their main appeal lies in the almost iridescent glow evidenced by the tiny glandular hairs on the leafy flower stalk and calyces. A clump of any *Engleria* saxifrage is a showy affair in bloom but the bold, silvery rosettes are a dividend at any season. Many hybrids between the *Englerias* and *Kabschias* exist, as well as pure species, in commerce. The loveliest of these is unquestionably *S. grisebachii* Degen and Dorfl. Wisley Variety, but all are plants of animated interest in the garden.

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With such a wealth of plant material at our disposal, it is a pity that so few Colorado gardeners have cultivated these plants. They can adapt to garden conditions with ease on the plains, and would probably prove little weeds in gardens in higher elevations, if people would only attempt them.



S. lilacina x *S. marginata*

The Shofu-en

Japanese Garden Is Dedicated

Gloria Falkenberg

76 The Shofu-en, a 2 acre classic Japanese garden at Denver Botanic Gardens was dedicated in mid-afternoon Saturday, June 23, 1979. Arranged in cooperation with "Japan Today" this was an historic occasion. More than 400 dignitaries, honored guests, members and friends of the Gardens shared in this joyous occasion.

Lawrence A. Long, Past President of Denver Botanic Gardens, was master of ceremonies at the dedication. Dr. William G. Gambill, Jr., Director, who welcomed the many guests and distinguished visitors, announced the garden has been named Shofu-en, the Garden of Pine Wind.

Minoru Yasui, Executive Director, Commission on Community Relations of the City and County of Denver, welcomed the many dignitaries and thanked the Senior Bonsai Club for contributing many artistic trees which members had dug and wrapped for the garden. He then presented the Reverend Fumio Matsui, Shinto priest of the Konko Church in San Francisco, California, sponsored by Dr. and Mrs. Takashi Mayeda, who gave the blessing. Shinto banners, suspended from the overhang of the Cheesman Park gate, provided the

backdrop for an altar bedecked with hackberry branches and a Norfolk pine tied with white ribbons. Rice cakes and large vessels of saki were also part of the planned ceremony. Although heavy rain delayed the blessing and caused Rev. Matsui to shorten the ceremony, he declared it a very good omen; the rain cleansed and purified the sky and atmosphere for the blessing of the garden.

Following the ceremony of blessing John C. Mitchell, II, President of Denver Botanic Gardens, told how this dream of many years, soon to become reality, will be enjoyed as an art form, for quiet reflection, and as a union with nature. He then dedicated the garden to the City and County of Denver and to the State of Colorado. The Honorable William H. McNichols accepted Shofu-en for the City. He expressed gratitude for the gift of this exceptional garden and for the generosity of the Japanese-American community. The Honorable Consul General of Japan, William K. Hosokawa spoke of Denver's expanding cultural horizon and of the importance of this addition to Denver's beauty and cultural assets. This garden is a permanent monument to the ideals of understanding between the two nations, he said.

Professor Koichi Kawana expressed his thanks and appreciation for the support of the Trustees, the Staff, the Japanese-American community, People to People Corporation, Inc., the Bonsai Club, Ikebana International, Denver Chapter.

Mrs. Falkenberg, a volunteer at Denver Botanic Gardens for almost 20 years, is a Trustee. She has worked closely with the Japanese-American community since 1977 in fostering the garden and arranged the program for the dedication.

Then Mr. Mitchell, Mayor McNichols, Professor Kawana and Dr. Gambill cut the bright red and white ribbons on the Japanese gate, opening Shofu-en for all to view.

Tea Ceremony Performed

Master Soju Takahashi, sponsored by the Urasenke Foundation of Kyoto (one of the principal tea ceremony schools), and Mrs. Takahashi were introduced by Mr. Yasui. After presenting a gift to Mayor McNichols, Master Takahashi proceeded to the Tea House to prepare for the ritual of the tea ceremony. Purpose of the artistic ceremony is to be among friends and at peace with oneself. It is not a casual gathering but a profound event, fraught with symbolism. Master Takahashi prepared the tea in front of his honored guests

and observers in a series of precisely choreographed movements. It was his pleasure to serve the guests and to share a unique moment of understanding, friendship and goodwill.

Honored Assistants were Mrs. Soju Takahashi, Mrs. John Yamazaki, Mrs. Kyoto Kita and Mrs. Hiroko Morita. Honored Participants were Mr. Kim Thrasher, Mrs. Fay Carter, representing the President of Denver Botanic Gardens; Mrs. J. Kernan Weckbaugh, Weckbaugh Foundation; Mrs. Takino Takamatsu, representing the Mayor; and Mr. William K. Hosokawa, Honorary Consul General of Japan.

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Reverend Fumio Matsui Blessing the Garden

78 Honored Observers were: Ms. Louise Dunlop, representing the Governor of Colorado; Mr. Y. Kataoka, Senior Bonsai Club; Mr. George Inai, Senior Bonsai Club; Mr. Frank Torizawa, Japanese Association of Colorado; Mr. Eijiro Kawamura, Japanese Association of Colorado; Dr. Ayako Wada, People-to-People, Takayama, Japan; Mrs. C. L. Barker, People-to-People Corporation, Inc.; Mrs. Phil Hayward, Ikebana International, Chapter 66; Mrs. Ancil W. Winger, Ikebana International, Chapter 66; Mr. Harold Sasaki, Denver Bonsai Club; Mr. Keith Jeppson, Denver Bonsai Club; Dr. William G. Gambill, Jr., Denver Botanic Gardens; Professor Koichi Kawana, Denver Botanic Gardens; Mr. Ray Moroye, Simpson Methodist Church; Reverend Unryu Sugiyama, Tri-State Buddhist Church; Dr. William Takahashi, Japanese-American Citizens League, and Mr. Minoru Yasui, Commission on Community Relations.

The Ceremonial Tea House, a generous gift from the Ellen Mullen Weckbaugh Foundation, is one reserved for ceremony, plant or floral displays, and an educational tool to promote international understanding. The authentic tea house and gate were fabricated in Japan, disassembled there, then reassembled at Denver Botanic Gardens by Japanese workmen.

For the dedication and ceremony 25 bonsai were exhibited by members of Denver Senior Bonsai Club. During the tea ceremony the other guests were invited to wander through the Gardens and to view lovely Ikebana floral arrangements in Horticulture Hall

while enjoying refreshments. After the formal tea ceremony they were also invited to view the interior of the tea house.

The Shofu-en, nearing completion, became a special project 15 years ago when a magnificent stone lantern was donated by Denver's sister city, Takayama, Japan. The specific plans gained impetus in June 1977 when our Board of Trustees voted to retain Professor Koichi Kawana, professor of Japanese art and landscape design at the University of California in Los Angeles, to design the garden. The garden gained further momentum in the autumn of 1978 and during these past three months progress has been phenomenal. Generous contributions from many other organizations and individuals including members of Denver's Japanese-American community, made this garden possible.

The freshening rain on June 23 accentuated the fragrance of the pines. With the reflection of the snow lantern in the lake, the delicacy of the Japanese iris blossoms nearby, beautiful women attired in colorful kimonos, the distinctive character of the glistening pines, hope had, indeed, become reality. This was a garden of tranquility and serenity.

Denver Botanic Gardens has commemorated a very significant day in its history — the dedication of Shofu-en, the Garden of Pine Wind.

Dedication by President

At the dedication of the Japanese garden, June 23, 1979, Mr. John C. Mitchell, II, President of Denver Botanic Gardens, said: Mayor McNichols, honored guests, friends of Denver Botanic Gardens:

This is a most significant day for the Denver Botanic Gardens. We are not only bringing to an end a very interesting, three-month long event, "Japan Today", in which we have all participated but are also dedicating a new garden, one which we have dreamed about, if you will, for a long time.

This Japanese Garden has been designed to display a beautiful and different art form — one that will provide a contrast in design and plant material from the other sections of these botanic gardens. But it will be more than that. It will provide a quiet place for reflection; for many, a place to escape from the busy world around, to gather one's thoughts together, perhaps to sense a closer union with nature.

And that will be, of course, just what our talented architect, Professor Kawana probably has hoped might happen as he adapted the centuries old Japanese Garden traditions to this high, arid country to make this garden.

This garden has been in our planning for many years. It gained its present location in our

Master Plan of 1969, although earlier attempts had been made, and the beautiful stone lantern beside the gate was a gift to the city from the City of Takayama, Denver's Sister City in Japan, a number of years earlier.

Fortunately we were attracted in 1977 by Professor Kawana's abilities when we saw the newly opened Japanese Garden at the Missouri Botanic Gardens in St. Louis. His ideas and design provided a spark for our Development Fund Drive later that year when the community responded to our efforts to raise \$1,500,000 for this and other needs of Denver Botanic Gardens. And when that drive was successful, construction started here and on the Rock-Alpine garden to the south in mid-1978.

One of the most gratifying aspects of this project has been the joining of forces which have made it a reality. The Japanese-American community under the leadership of Minoru Yasui and Bill Hosokawa has stepped in

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Ribbon Cutting Ceremony
Dr. William G. Gambill, Jr., Mayor William H. McNichols, Prof. Koichi Kawana, Mr. John C. Mitchell II

most hearteningly to help. Part of that community, members of the Denver Bonsai Club, have been responsible for a major portion of our pines which they personally searched out, dug, balled, and brought to us from the mountains (and they are still at it). Their gift is invaluable. The Denver Chapter of Ikebana International has been generous financially and encouraging. A few months ago we gathered nearby to accept some additional gifts in the form of lanterns from the City of Takayama whose mayor was here with a group of citizens.

These and many others have joined us in this project. And then for a final stroke of good fortune, in memory of Ella Mullen Weckbaugh, a prominent Denver citizen and one who loved gardens, the Eleanore Mullen Weckbaugh

Foundation and the Ella Mullen Weckbaugh Benevolent Corporation have given the beautiful tea-house and bonsai display room which you will see on the north side of the lake. This is a magnificent addition to this garden which we had not expected to have for years. It was a sort of "dream within a dream"! We are most grateful to the trustees of those two foundations.

So much for the history of this far from finished Japanese Garden. But finishing will take years, and it is ready now to be seen and enjoyed.

Therefore on behalf of the Trustees and Staff of Denver Botanic Gardens I take great pleasure in dedicating this garden to the cause of international peace and goodwill, particularly as characterized by our Japanese-American relations, and further I am most grateful to be able to present this garden to the people of Denver and Colorado.



Guests and Dignitaries at Dedication Ceremony

Mount Everest at Dawn to the Taj at Dusk

Jeanette George

Twenty-eight members of the Denver Botanic Gardens set out to conquer Mt. Everest in March 1979. Many Colorado climbers have attempted to reach the peak. We would succeed — with cameras, only, of course!!

The entire group left London together for India. The chill of rain and snow in London was soon forgotten when we reached New Delhi very early on a Sunday morning. The local guide greeted each person with a fresh flower lei of mums and marigolds and guided us to the luxurious new Maurya Hotel.

A chorus of birds was tuning up to greet the new day as we were turning in. Soon noise below prompted investigation. One could just see the swimming pool and some shadowy figures who were cleaning the terrace. As it grew lighter, one could see a human chain of earthmovers quietly walking along the fence with baskets of dirt on their heads. In a few minutes they went back with empty baskets for another load. A few hours later in the daylight we could see construction under way, and that the earthmovers were women in saris.

Later in the day our city tour of Delhi took us down embassy row where we saw many beautiful women in brilliant saris. When

asked if it was because it was Sunday that people were “dressed up,” the guide answered that New Delhi is the nation’s capital and many well educated and well paid government employees always dress in that fashion.

A first impression of India was a colorful one. We drove by the parliament buildings and the President’s house which sits at the end of a long driveway, enclosed by a tall wrought iron fence and gates. 81

The architecture of the buildings and landscape design of the gardens are typically European and reflect the British influence when this was the British Viceroy’s residence. The gardener’s comment was so typical: “You should have come a month ago when the spring garden was in bloom!” However, the beautifully patterned beds edged with clipped boxwood are interesting at any time of the year.

Nepal Entrancing

The next morning we were off to Katmandu, Nepal.

Many of the Nepalese people are short in stature, including the sherpas on the climbing expeditions who carry incredible loads on their backs. The village women carry huge baskets held by a band around the forehead.

Mrs. Jeanette George, a Boulder resident, is a long-time member of the Denver Botanic Gardens. She was an enthusiastic and interested member of the group which made the trip she describes.

After lunch we took small overnight bags to fly out to Pokhara to Fish Tail Lodge. It is situated across the river from the village.

The arrival of the silver bird each afternoon at the Pokhara Airport is the entertainment for the day. A loud whistle is blown 15 minutes before plane time so that pedestrians and animals will clear the airfield. It is also the signal for the natives to gather under the pipal tree which is the outdoor mailing room, or by the fence.

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The bus from the lodge discharges passengers by the river's edge. Steps have been built into the bank. Once down and onto the log raft we were pulled across by rope pulley to the other side.

It's early to bed, for the wake-up knock on the door will be at 5:30 a.m., to be out at 5:54 to watch the spectacular sunrise on the Annapurna Range. The Fish Tail Peak is so named by the natives as it is the peak which looks like a forked fish tail pointed skyward. It is Mt. Machhapuchhare. First, dim rays of purple outline the highest peaks, then as though with a bright pink pencil the rugged peaks are limned. Gradually more of the mountains become visible, the pink turns to gold and ultimately the entire range appears in gleaming white. From the lodge which is at 3000 feet those awe-inspiring peaks are only 25 miles away but rise from 22,956 feet, the height of Mt. Machhapuchhare, to Annapurna I, II, III, and IV at heights of 24,858 to 26,500.

If the cultivated areas and the buildings along the lake look relatively new, it is because they are!



Nepalese Sherpani

Until the 1950s the area was malaria ridden and there were no people living there. The government launched a campaign to eradicate the mosquito. Now gradually villages have been established.

Tiger Top Jungle Lodge is located inside Chitwan National Park about an hour's flight from Katmandu to the east and near sea level. The nearest airport is Meghauly, an airstrip separated from the village only by a line of stones marking the boundary.

Our elephant ride came in the cool of late afternoon. For two hours we stalked the Indian one-horned rhinoceros, which is protected in the park. As the elephants came single file with the wooden rack

strapped to their backs, we looked for the ladder to climb up. Instead we were directed to line up on the stairs to the lodge. The elephants were as tall as the first landing. We stepped into the rack, called a howdah, and slid down on the heavy pad to straddle one of the corner posts. Thus four people ride on each elephant.

Many colorful birds and wild peacocks were flushed out. The small deer and rabbits scampered away as the elephants approached, plodding along. However, when the scout standing on the back of the lead elephant motioned, the drivers quickened the pace and the elephants converged so that the animal was cornered for all to get a look.

Wild Flowers In Park

Young naturalists, employed at the park, gave talks and hikes to see the wild flowers. When asked about the monkeys in Chitwan National Park he replied, "at the bend of the trail look up into the large tree." To be sure, dozens of curious black-faced white monkeys were looking down at us. The bait was put out for the tiger, but he was a no-show on that particular night.

The city tour of Katmandu took us to Durbar Square where we got a glimpse of the Living Goddess who is chosen at about six years of age and lives in the temple until she is 13 years old when another Goddess is chosen. Kasthamandap, from which the city gets its name, is a temple made of the timber of a single tree — The Palace of 55 Windows. Outside the city on a hill is the Swayambhunath, a 2500 year old stupa which overlooks the Katmandu Valley. Rugs were bought, made by the Tibetan refugees.

The grounds at the Malla Hotel were beautifully kept. Sweet peas on a wall on the east were very fragrant. Birds of paradise and amaryllis were growing like perennials. Roses and fruit trees were lending fragrance; along the walk on both sides were clay elephant planters with petunias and vining plants in them. A large permanent bird cage held dozens of parakeets. The man who fed and cared for the birds each evening also kept fresh flower arrangements in the lobby and flowers in the dining room. 83

Everest from the Air

Everest on the "Dawn Patrol" was certainly a highlight of the trip.

Each person was allowed into the cockpit for a panoramic view of Mt. Everest and surrounding peaks, and of course, to take pictures. The wisps around the peaks were blowing snow and freezing temperatures. We soon ran out of superlatives and became contemplative. We had conquered Mt. Everest! With our cameras!! We were back in time for breakfast at the hotel. Then we flew back to New Delhi.

We rode to Agra by bus.

It was by the "Dawn's Early Light" that we got our first glimpse of the Taj Mahal.

In retrospect, we saw India at Night in a way that we certainly would not have otherwise. Not long out of Delhi, we saw what looked like the silhouette of a camel caravan of tremendous loads of hay. It was! From elephants as beasts of burden in



Group on Safari

Nepal to camels in India — there were many camel caravans later but seeing the first one was a thrill.

Most of the traffic was large trucks. They, and we, stopped many times to pay toll. Often there was a lantern light or a bare electric bulb by which a man could be seen making tea. By the light we saw beds in front of shops as we went through the small villages.

Instead of moonlight, the day was breaking as we arrived at the hotel. At any time and in any light, the Taj Mahal is breathtakingly beautiful. A close-up view reveals exquisite detail and workmanship. It has been described as marble lace with jewel inlays. The four towers at the corners of the building are prayer towers with center dome over the tombs. The entire scene is reflected in the garden pools. A formal garden with slender Italian cypress trees for accent is impeccably kept.

The main Botanic Gardens are located at Lucknow. However, many estates and historic spots have maintained gardens in the manner of the pleasure gardens of the Moghul rulers.

Gardens Visited

The new luxury hotels have beautiful grounds with resident landscape gardeners. Dr. Gambill was invited by the head gardener to tour the grounds and greenhouses at the Mughul Hotel. The diverse plantings included a rose garden, annual and perennial gardens, blooming trees, and bougainvillae romping over the fence and walls. Beautiful green parrots and mynah birds among the trees were flying free. Many weaver birds' long tear-drop nests hung from the trees.

Peshawar, at the foot of Khyber Pass, is close to the border of Afghanistan. In the bazaars were to be found many different articles of copper, brass, wrought iron and gold and silver jewelry. The colorful spice shop was a feast for the nostrils. A scene on a tray outside

the shop caused much comment. The browns, reds, oranges, yellows, and mustard colors of the spices were used to "paint" a picture for the visitors.

From Peshawar, the highway to the Khyber Pass goes through "the tribal area." In return for the right of way through their tribal lands, which are not under the jurisdiction of either Pakistan or Afghanistan, the governments of both countries provide water, electricity, and schools.

The landscape is bleak. It is an arid country, rocky, treeless and dusty.

In direct contrast to the unproductive area, we came upon field after field of gorgeous opium poppies. They were of many shades of orange, pink, red and bicolor, with royal blue being the most valuable. It is hard to reconcile such innocent beauty with the final destination of poppy seed — which is hashish. This too is outside the law of the Pakistani government.

From Rawalpindi we flew north to Gilgit, a fairly short flight, but one always depending upon the weather. Hunza has fascinated many people for many years. The average old age is between 105 and 120 years. It would be our good fortune to meet the Hunzakuts and see the valley of 180,000 apricot trees in bloom. It was glorious to look upon! The billowy pink blossoms started at the Hunza River's edge and carried color up to the mountain top. Apples, pears, and plums also abound in the valley. Before — the roads to Hunza were so narrow and treacherous that only jeeps could make the trip. People traveled by foot mostly. In December 1978 a new road was built by the

Chinese from the border into Gilgit, approximately a 70 mile stretch. Instead of suspension bridges there are now three fine concrete bridges definitely of Chinese design. Since the road is new, we were the only mechanized vehicles on the road that particular day.

Terraced Hillsides

There is practically no level land, so the terraces up the hillsides are where they grow vegetables. There are so many fruit trees that anyone who happens by in harvest season may pick as much as he wishes. The only means of preservation seems to be drying, usually on the roof tops, which are flat.

Hunzakuts laugh a lot and are a happy people. It is said that they are descendants of Alexander the Great. There is no incident of cancer in the state of Hunza today, but the elders fear that intermarriage may result in cancer being brought in. One wonders about the effect of Laetrile since apricot pits are eaten like candy. In fact, candy was discouraged by the elders.

In the bazaar were to be found dried apricots, dried mulberries, and apricot pits along with almonds and other goodies at the nut shop. Each pit is about half the size of an almond. There are a great many in a kilo. When asked if they are shelled by machine or if each is cracked with a hammer, the answer was, "No, with a stone."

Back at the Rakaposhi Inn, we enjoyed the view of Rakaposhi Peak, 26,000 feet. The beautiful big

Chinar trees have maple-like leaves and smooth grey bark like a sycamore. The gardens of the hotel are laid out in 8' squares. Earthen sides are built up to hold water like the rice paddies. The squares alternated with red tulips, dark and light green foliage which turned out to be spinach and lettuce. Peas were seen in another square and annuals for the dining room filled some of the plots. Fresh spinach was enjoyed for lunch one day.

Monday morning we were packed ready for an early flight back to Rawalpindi. However, we were told the plane might not come in. We sat in the lobby awaiting further instructions. At noon we unpacked again for another night. It was Thursday before the morning "rehearsal of getting ready to leave" was the real thing. We had waited so long to see this area of the world, a few days more or less did not really matter. However, on the fourth day the sun was shining brightly and the plane came in for us.

The route flies over the meeting of four great mountain ranges at Pamir Knot, the Hindkush Range, the Karakorams, the Pamirs, and the Himilayas. All are over 24,000 feet. At one point it seemed so close that one could reach out and scoop up a handful of snow. The world was encompassed all around in glittering, glaring sun on the snow and in silence.

Srinagar, Kashmir was the last stop of our tour before flying back to New Delhi to catch our Pan Am

plane for home. There was some question about the safety of Americans in Kashmir. Seven people had been killed the day before. We were whisked through town in a very crowded bus with a truck of 20 soldiers going ahead. Once across Lake Dal, we stayed on the houseboats and did not go into the center of town. We did go to see the Shalimar Gardens and Nishat Bagh. It was forsythia time and the lanes were lined with large bushes, unpruned, waving long graceful branches in the breeze.

Houseboats in Kashmir

The houseboats, which came equipped with servants, we found fascinating. They are very modern — beautiful chandeliers, oriental carpets and very nice furnishings. Each spacious bedroom has its own sparkling white bath. We were told that the British wanted to buy land for summer houses in Kashmir but were denied. They brought boats and lived on them on the lake.

The merchants came in little boats with all kinds of merchandise which they spread out on a blanket for our inspection and purchase. Anything from toothpaste and film to flowers and fur hats and jackets could be purchased from the boatmen.

After dinner the jewelry merchants spread out jewels, set and unset, for us to look at. The shop which carries cottage industry embroidered shawls, jackets, dresses and skirts was open all day, half the night, and all day Sunday. The Shikaras, those colorfully upholstered little boats with the canopy and fringe on the top, took us through the canals and to the factory where the carved wood

articles are made. Floating islands which have large trees and other plants growing on them seem to have no permanent attachment to the land. A houseboat was being handcarved for delivery some three years hence. The lacy wooden mouldings just under the roof and the filigree around the edges of the boat were all hand-carved and very elaborate.

A leisurely morning on the sun roof watching the wild parrots and other birds which we could not name, the reflections of oars of a shikara dipping into the lake close by, and the far-off horn calling the Moslems to pray, the pink of the almond trees blooming across the lake high on the hillside — these are a few of the favorite things remembered about Kashmir. On this peaceful note our shikaras took us back across the lake to the taxis for the airport.

One evening as the boat boy and I were gliding into the landing of our houseboat, from the veranda I overheard, "Has anyone seen Jeanette this afternoon?" "No" was the answer "but wherever Jeanette is she's having a good time." I thank her for that observation. That, after all, is what a vacation is for — a rest from one's labors *or* a change of scenery *or* a time of learning about different cultures and different people *or* a chance to become acquainted with other adventurous people. No one on the tour considered it a rest. Every member agreed that the other reasons for a vacation applied to this "Once in a Lifetime" "Never to be Forgotten" "Beyond the Lost Horizons" Tour. 87



Mural — Katmandu Airport

Focus on *Clerodendrum* in the Boettcher Memorial Conservatory

Peg Hayward

Mrs. Peg Hayward's long association with the Boettcher Conservatory enables her to write about the plants housed there. "Focus on" has been a regular feature of *The Green Thumb* for several years.

- 88 The Verbenaceae family includes numerous vines and vinelike climbers. Probably the best known are in the genus *Clerodendrum* consisting of about 560 species and varieties. The name is derived from the Greek *kleros*, chance, and *dendron*, tree.

Clerodendrum are of wide geographic distribution, but most abundant in tropical and semi-tropical Africa and Asia. They are found wild in four of the five continents, the exception being Europe. Only two of the climbers and a hybrid are widely cultivated.

Clerodendrum thomsonae Balf. f. from West Africa is one of the most popular. Commonly known as bleeding heart, glorybower, bag flower, magic flower, this vigorous evergreen twining, shrubby vine can be kept to convenient indoor size by pruning during its semi-dormant period in winter. It is,

also, well suited for growing on arbors and trellises. Records show that it has been in cultivation since 1861 when it was introduced into Great Britain by a West African missionary. Shiny green leaves, borne in pairs, are sharp-pointed, 5 to 6 inches long and up to 3 inches wide, and rounded at the base. Quaint little red and white flowers demand attention. They are produced in loose clusters near the ends of the branches, mainly in the summer months. The pure white, baglike calyx surrounds a crimson-red corolla. The crimson portion or true flower is composed of a slender tube extending beyond the calyx and spreading into five lobes. Characteristic of the flowers, a group of long projecting stamens extends beyond the corolla and turns inwards at their tips. After blooming is over, the calyx turns violet-pink and fleshy fruits turn from green to blue or purple.

When in full bloom this spectacular plant is exhibited on a trellis in the lobby court of Boettcher Memorial Conservatory. The related *C. speciosissimum*, Java glorybower, makes a brilliant display during the month of May. It may be seen growing on one of the lamp posts in the Boettcher Memorial Conservatory.

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Clerodendrum thomsonae

Weed Killers

James Feucht

- 90 The hoe and the dandelion digger are almost antiques, what with the myriad of chemicals available for weed control — or so we thought. A recent spot check of garden centers, discount stores, and supermarkets discloses that, while there are many chemicals available for weed control in the home gardens, a recent suspension order by the Environmental Protection Agency (EPA) has had its affect and has drastically reduced the types of weed control products that were commonly used. Any product containing 2,4,5-TP (Silvex) has been suspended and unavailable for purchase since last spring. The suspension order reads as follows:

“Registrations issued under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) as amended, 7 U.S.C. Section 136 *et. seq.* of all pesticide products containing 2—(2,4,5-trichlorophenoxy) Propionic Acid (Silvex) for forestry uses (including site preparation, conifer release, and brush and weed control), rights-of-way uses (including brush and weed control), pasture uses, home and garden uses, commercial/ornamental turf uses (including recreational area uses), and aquatic weed control/ditch bank uses are here-

by suspended and the sale, distribution, or other movement in commerce, and the use of all such pesticide products for the foregoing uses is prohibited.”

The *Ortho* brands, products of the Chevron Chemical Company, appear to be the hardest hit by the suspension order since many of the weed control products manufactured by this company contained Silvex, an especially effective chemical for the hard-to-control weeds such as clover, chickweed, and ground ivy.

Whether through error or a misunderstanding, some stores apparently withdrew all products even if they contained only 2,4-D. This seems to be the case with Sears Roebuck and Company where the only weed control product available was “Spot Weed and Grass Control”, an aerosol containing a contact herbicide known as Paraquat. The only other product on the shelves was a soil sterilant called Triox. More will be said about that later on.

Most garden centers and nurseries and some of the discount stores, however, carry a much wider line of weed killers for nearly every weed problem one might encounter. Ortho products available in most locations included “Weed-B-Gon”, available in a “Jet Weeder” aerosol containing 2,4-dichlorophenoxyacetic acid (2,4-D) and 2 methyl-4-chlorophenoxypropionic acid (MCPA). A liquid formula called “Super D Weedone” con-

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tains 2,4-D and 3,6-dichloro-o-anisic acid (Dicamba). These are common ingredients in nearly all of the broadleaf weed killers for the control of dandelions and similar types of weeds.

Products similar to Ortho's include "Ferti.lome Systemic Weed Killer" and "Colorado's Own Dandelion Weed Killer". Each of these products is somewhat different in its formulation and the concentration of the active ingredients. "Colorado's Own" product contains 24.6% 2,4-D and 2.0% Dicamba. The Ortho product contains 20.3% 2,4-D and 1.9% Dicamba. "Ferti.lome" contains 0.23% 2,4-D and 1.43% Dicamba. Application rates vary with each product thus pointing to the need to read the label always.

For special broadleaf weed control such as bindweed, "Colorado's Own" markets a product called "Bindweed Control," containing 49.3% 2,4-D. They also market special products for chickweed and clover control containing 3.87% Dicamba and a spot clover killer available in granular form containing 1.5% Dicamba.

"Ferti.lome" carries a product called "Crabgrass, Nutgrass and Dallis Grass Killer," containing 13.2% monosodium methanearsonate (MSMA). This is a post-emergence grass killer that is selective on certain types of grasses such as crabgrass. It is not usually effective as pre-emergent (prior to seed germination) control of these annual weeds. For spot grassy weed control "Ferti.lome" markets a product called "Dowpon M Grass Killer", containing the sodium and magnesium salts, Dalapon. This is a contact killer and does not generally control vigorous grasses such as quackgrass. "Ferti.lome"

also markets a 5% Dacthal in a granular form for pre-emergent control of annual weeds. It is called "Garden Weed Preventer".

Less common on the market is a product of Dexol Industries, California, for control of broadleaf weeds in the lawn. This brand contains Trimec which is a combination of 2,4-D, MCPP, and Dicamba. A similar formula is sold by Gorden Chemicals but generally not as available to the gardening public. It is mainly used in park recreation areas and golf courses.

"Weed and Feed"

Also available are the so-called "weed and feed" products in which a weed killer is put in a lawn fertilizer and both applied at the same time. The most well-known in Colorado, as well as much of the United States is "Scott's Plus 2". Until a few years ago this product contained Dicamba but because of problems with Dicamba injury to trees in the lawn area, the product's formula has been changed. It now includes 0.75% 2,4-D and 0.75% MCPP. "Ferti.lome Weed Killer + Lawn Fertilizer" contains 0.17% 2,4-D and 0.75% MCPP and 0.07% Dicamba.

A similar weed and feed product is available under Colorado's Own label.

In a few nurseries and garden centers, a Monsanto product called "Roundup", (41% Glyphosate) is available at an extremely high price and in quantities no smaller than one-gallon sizes. The average price is \$85.00 per gallon.

Expensive as this product is, however, research and experience over the past few years have shown that "Roundup" is the only product that will satisfactorily control quackgrass and bindweed. Since it is a non-selective chemical, it cannot be used in the lawn area. It will kill bluegrass just as quickly as it does any weed. Despite this, it has distinct advantages over soil sterilants such as Triox.

because it is possible to replant an area seven days after treatment, whereas Triox and other similar sterilants may take several years to dissipate. In the meantime these sterilants are causing damage to trees and shrubs from drift, movement in the soil by water, and the growth of tree roots into the treated areas.

While this was only a spot survey and undoubtedly many other products of a similar nature are available in local marketplaces, the important question is: How does one go about selecting the proper herbicide to do the job? Following are some tips and precautions that can be used when selecting and using weed control chemicals:

1. **Identify the weed first.** If you are unsure what kind it is, consult your local county extension office. The best procedure is to take a part of the plant into the office for identification. Be sure that you include as much of the root system as possible. It is important to know whether the weed is an annual or perennial, a broad or narrow leaf (grassy weed).

2. **Consider where the weed is located.** If it is found in a lawn area you will be restricted to the use of chemicals that will be selec-



tive, such as 2,4-D for controlling broadleafed weeds without harming the grass. If it is a perennial, grassy weed, only spot treatment should be considered. If in a flower bed or shrub border, or if there are many weeds in the vicinity of the roots of trees and shrubs, it is best to avoid any product that is high in Dicamba, and then use only spot treatment if possible. It has been found that Dicamba can accumulate in the soil, ultimately reaching the root systems of trees and shrubs, causing their damage or death. It would be best to avoid any product containing Dicamba in which the percentage is greater than 1.5%. Weed and feed type products containing Dicamba can be particularly troublesome because they are not generally applied as a spot control, being broadcast over the entire lawn, including the root zones of trees. They are usually applied more frequently and thus, can accumulate to a level toxic to trees at a faster rate. It is best to avoid a weed and feed fertilizer if you have trees and shrubs in the lawn area or if they are adjacent to the lawn. The roots of well-established trees will extend well beyond the so-called drip point or branch extremities of the tree itself. It has been found all too often, too late, that even staying some distance from the drip point of trees can still result in damage to the trees from weed and feed products containing Dicamba.

3. Avoid hose-attached sprayers for most weed-killer applications. While it is easier to apply liquid weed killers with a hose-attached sprayer, they should be used *only* in large lawn areas where there is no danger of drift to adjoining property or trees, shrubs and gardens. Hose-attached garden sprayers are difficult to control and use large volumes of water. A better method is to use a hand pump-type sprayer. The handiest size is the 2½ gallon container. These sprayers allow you to control the pressure, have a fingertip control for the nozzle, and an adjustment on the nozzle to control droplet size.

4. Permanently label the sprayer used for weed control with the words, "Weed Control Only". This sprayer should not be used for spraying insecticides or fungicides, particularly on trees, shrubs, and gardens because it is too difficult to wash away all of the residue of several of the weed control products available. A slight amount of contamination can have dire results on sensitive plants such as green ash, tomatoes, grapes, and beans.

5. Before you buy the product, read the entire label. Make sure it is formulated to control the weeds you are trying to control and particularly, follow all precautions. This should be done every time you purchase any product. The name may be the same but the formulas do change.

6. Never purchase a "total vegetation control" chemical if you intend to use it near trees, shrubs, gardens, or where it may be washed into these areas, or where the roots may ultimately extend into these areas. They should not be used on paths, drive-

ways or other compacted surfaces because they will be readily washed into areas of desirable vegetation. When you get right down to it, there is probably no legitimate use for soil sterilants in the home landscape. Here is a case where the gardener must decide on the risks involved. It is far better to put a little more work into it and even get out the hoe and dandelion digger, or pay the price of a product such as "Roundup" that will kill the weeds but not sterilize the soil, than to pay the far bigger price of the loss of trees and shrubs for years on end.

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7. Keep all pesticides, including weed killers, in their own labelled containers and away from foods or where food may be served. They should also be stored away from garden seeds, stored bulbs, or any other garden plants. The fumes from many of these products can damage both seed and plants.

8. Some pesticides, including herbicides, should not be stored where they will freeze. Freezing may cause a separation of the chemical from the emulsifier, rendering them unsafe for use. Stored in the garage next to a heated wall of the attached dwelling is usually the most satisfactory place.

9. Avoid spraying on windy days. Use a sprayer with large droplets and the lowest pressure practical. Chemical weed control is not always the answer to the problem. Perhaps the old-fashioned method of using the hoe and dandelion digger is not so bad after all. They can provide exercise, cost

less, create fewer problems, and can give you the final satisfaction of actually seeing the weeds routed out of the garden.

In a home garden perhaps a combination of both mechanical and chemical weed control methods is the answer. It is up to you to evaluate this based on each individual situation and the types of weeds with which you are dealing.

Mechanical control of some weeds merely cultivates them. This method of controlling bindweed and quackgrass rarely, if ever, gives satisfactory control. Here is a case where chemical methods would be appropriate.

A garden with some newly-emerging weed seed around which there are many valuable plants might be better cultivated than to take the risks involved with chemical control.



Reverend Fumio Matsui

The Vascular Connection

Pat Duhnkrack

In the Botanic Gardens Conservatory there are special opportunities to observe the inner workings of woody plants, without cutting the plant to do so. Fortuitously enough, some plant parts remove themselves naturally, and expose the structures within — just like opening the oven door to see what's cooking.

Look at the trunks and branches of the woody plants. There you will see variously shaped impressions; these are "leaf scars," formed when the older leaves drop off. The characteristics of these scars provide the clues to the internal structures of the plant.

The scar itself can range from a thin line, parallel to the ground, to a horseshoe-shaped configuration, to a circular patch. Within the scar, there are small bumps, one to many, more or less obvious, depending on the plant.

Since the scars are formed by the falling off of the leaves, the shape of the scar corresponds to the shape of the base of the leaf stalk, or petiole. The self-healing philodendron, (*Philodendron selloum* C. Koch) found near the waterfall and the turtle pond, has probably the largest leaf scars in the conservatory, approximately four inches across, light in color with a dark circle towards the upper center.

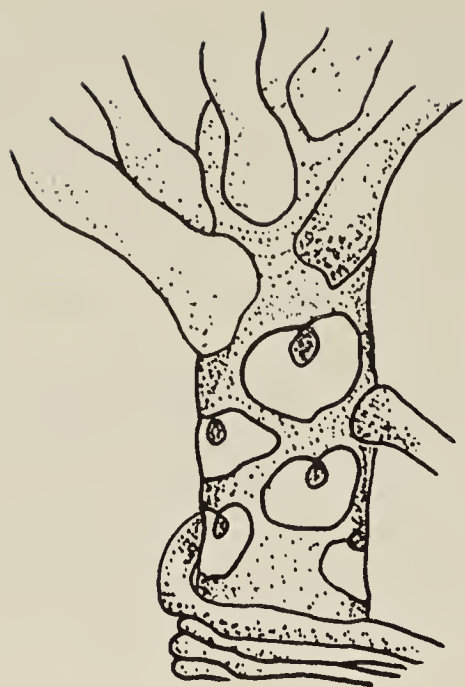
The larger light-colored area of the scar is the remains of cortex and pith, a region of support, protection, and storage. The small circle is what remains of the xylem and phloem bundles that once extended through the leaf stalk.

These bundles provided the vascular connection between the main trunk and the leaf itself. The water and nutrient materials from the soil traveled upward through the trunk of the philodendron through the petiole and out to the leaf. There, photosynthesis took place, manufacturing sugar and other foods, which were then transported back to growing regions of the plant and to maintain the structural framework. 95

A contrasting type of scar is shown by the snowflake tree, (*Trevisia palmata* var. *micholitzii* Viz.) on the south side of the Conservatory. Here the crescent-shaped scar has its vascular bundles in a linear pattern. It is as interesting and as attractive as the ornamental leaves and intricate flowers.

On all plants, the leaf scars are the result of abscission. Abscission is a natural self-pruning mechanism that removes old leaves, as well as ripe fruits and unset flowers, from the plant. As a gardener is apt to cover the wounds of mechanical pruning with tree paint, the plant makes a protective

Mrs. Patrician Duhnkrack majored in botany at Barnard College in New York and had finished most of her work for a masters college degree at the University of Wyoming when her Forest Service husband was transferred. For two years she has been a Conservatory Guide for the Gardens and has whetted her interest in the exotic plants in the Conservatory.



Self-healing Philodendron

layer, the cicatrice, to prevent desiccation and parasitic invasion. External conditions of light, temperature, water supply trigger the start of the process and cause the leaf to fall.

There are two functions in the abscission process, separation and protection. They occur simultaneously, in two layers.

The separation layer is characterized by enzymatic activity, reducing the cementing effect of the middle lamella by removal of the calcium and subsequent hydrolysis and rupture of the cell walls. The gradual senescence of the cells in the outer, or distal, portions of the leaf forces the nutrients back into the still functioning parts of the plant.

As degradation of the cell walls takes place, a protective layer of suberin and woundgum is laid down within the cell walls and intercellular spaces. In woody species, this layer is eventually replaced by periderm, contiguous with the periderm, or bark, of the stem.

At this point, with the cells of the abscission layer in a weakened condition, external forces, primarily wind, provoke the breakage. The resulting scar is already protected by the cicatrice, revealing parts of the internal vascular system. Frost is not always an important element in the fall of leaves: the Conservatory temperatures certainly bear witness to this fact!

In nature the fallen leaves contribute to a natural mulch and are part of the cycle of growth and decay. In the Conservatory, we can appreciate this process of leaf fall as a chance to see the internal tissues of the plant and to understand something of leaf physiology on a layman's terms.



Snowflake Tree

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The Green Thumb

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Denver Botanic Gardens, Inc. maintains a collection of living plants, both native and exotic, for the purpose of acquiring, advancing, and spreading botanical and horticultural knowledge.

This is a non-profit organization supported by municipal and private funds.

Bromeliad and Orchid House Started

Andrew Pierce

98 Since the last writing about the orchid and bromeliad house in the 1977 Winter issue of *The Green Thumb* (Vol. 34 No. 4) considerable activity has taken place both behind the scenes in the form of meetings and now more visibly in the form of excavations and building works at the west end of the Conservatory.

Most of you are familiar with the layout in that area. Part of the new structure will adjoin the existing tunnel, at almost the same level. The rest will be below, spreading out right up to the existing greenhouse that was built when the original Conservatory was constructed. It is difficult for people to imagine the design but in simple terms it will be a small dome, with a top similar to the Conservatory perspex diamonds, then a large greenhouse spreading round the base, rather like a skirt. When one looks across the Gardens toward the building complex from the south he will notice that the roof line will be somewhat complimentary to that of the top of the Education Building at the east end, though the junction line will of course be much shorter.

Much discussion has taken place in the past months as to the internal set-up of this somewhat revolutionary design. At one stage it was even contemplated having a three tier structured greenhouse but because of the problems of growing and the cost factor the middle floor has been eliminated. The problem of heat and sunlight influence along with energy savings and types of material used in the construction have been looked into, and we hope the end results will justify the erection of what will be a rather unique building.

Structural areas

The structure falls into two main sections:

A) The public display area under the dome with a viewing veranda which looks into the rest of the new greenhouse: This area is basically a 40 foot square with a 32 foot circular viewing platform, suitably protected by simple railings, that is connected to the existing Conservatory tunnels. In this area we can arrange large displays of orchids and bromeliads using plant material from the house below. In contrast to the Lobby Court displays it will be much more informal with no rigid lines to contend with as there are around the present pool. We will be able to do central displays of

Mr. Andrew Pierce is the Superintendent of the Conservatory for the Botanic Gardens. Several of his articles have been published in *The Green Thumb*.

plants set in lava rock, on pedestals, and the epiphytes on trees similar to their native habitats. Due to the load stress of the structure big heavy material will not be permissible and this in turn allows more freedom of expression. We would be wrong always to have a centralized display with the public walking round by the guard rail in such an area. Drift areas of plant material can be used right up to the rail allowing viewing sections at predetermined positions. Much of the plant material from these two families grows epiphytically and as such should be used to give flair to displays. We do of course, at the present time, grow the majority in containers, but display is another thing.

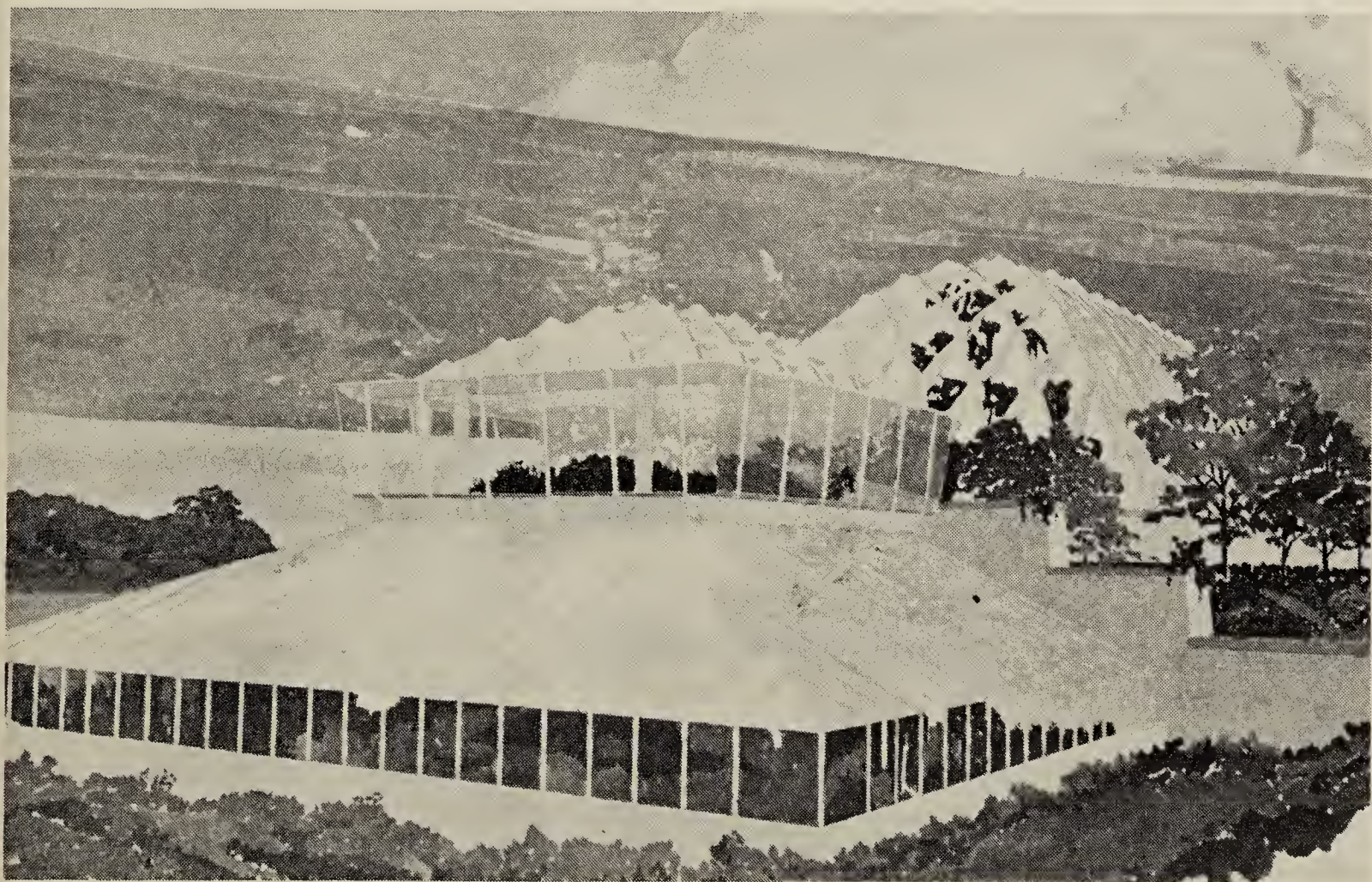
Connection from this area to the lower section will be by two means, namely a circular staircase on the south side and an elevator to the north.** The latter will have access to a separate tunnel out to the car park on the north side of

the present building complex. This can be conveniently used by staff to take in material and supplies both from the outside and internally, out of nature's elements, from the service greenhouses.

**(For service use only)

B) The lower level will be the principal greenhouse for our major collections of orchids and bromeliads and will not be open to the public though they will have excellent viewing facilities from the upper level veranda. To justify this — it is difficult at any time to obtain security of plants and also have the material on public display. We have one of the larger collections of bromeliads in the country and certain groups of orchids that are rather exclusive in the orchid world. Consequently they have a high monetary value. Our general experience shows that Denver people are extremely appreciative of exotic plants and plant losses are minimal, but at

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Architect's Drawing
Bromeliad — Orchid House

the same time there is no need to invite problems.

This area is almost 5,000 square feet (87 x 60) in size and has a head room of 16 feet over the center portion with the roof slope bringing it down to 7 feet at the periphery. The whole floor space is unobstructed excepting for six caissons that support the veranda above. These concrete caissons have been sunk into the ground some 28 feet, a depth necessary because saturation areas of water were found due to the varied strata existing at lower levels all over the Gardens.

At the present time the proposed roofing material for this section is Cyro, an acrylic twin walled rigid plastic some 5/8ths of an inch thick with vertical members. The problem of expansion during the summer and contraction at other seasons has to be overcome especially when one has almost 30 feet of reach to play with. This is a new material to us and it will be interesting to see how it works even though similar material is used extensively in glasshouse construction in Europe. One additional consideration here that they may not have is the possibility of a hail storm.

With the floor area relatively clear benches can be set up to meet specific requirements. In part the traditional flat bench will be dispensed with and what are known as vertical benches will be used instead.

These can be of various heights, in the form of an upturned V with the epiphytic plants on both sides. Due to their method of construction surface area is considerably increased over floor space and

they are especially suitable for *Tillandsias* and for orchids that are mounted on bark.

On the south side of the building there will be a suitable ramp constructed up from the main walk to the existing tunnel area so that the handicapped can come in and then roll down the present Conservatory grade, which with the gravel surface is a hard push up. Also as a last resort the elevator can be used but this will have to be staff operated.

Heating and Controls

The heating and cooling systems will be similar to our present arrangements using low pressure steam off the existing boilers and cooling pads where water is used to reduce temperature and to humidify air that is being drawn by fans at the opposite side of the structure. Air will circulate rapidly upward and then be exhausted above the tunnel area. With the Cyro acrylic plastic heat loss during the winter will be minimized due to its twin wall construction, and its internal structural bars will help shade during the summer. Quite often with Denver's high light and intense sunshine temperature build up, even when it is cold outside, can be quite dramatic. This has to be taken into account as well. Heat build up will take place in the top of the dome, similar to that in the Conservatory, and this will be exhausted by fans situated above the tunnel and consequently above people level. At the same time such air circulation is beneficial to plants and in the case of many epiphytes a necessity as their normal dwelling perch is high on a tree.

Bromeliads

During the past two years some members have had the opportunity to visit the service greenhouses and most likely they were aware of the congestion in that complex. At the present rate of acquisition our collections are doubling over a period of 5 years.

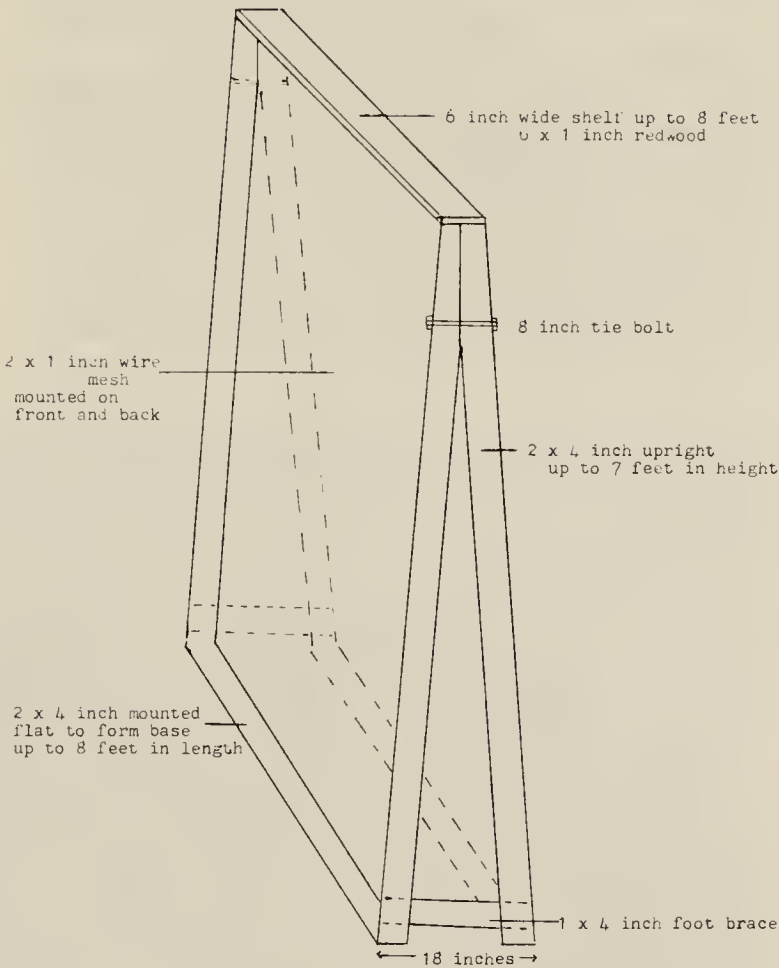
	Taxa	Plants
Up to 1975	2072	3269
1978	3313	4809
1979	3944	5791

Already this year we have added over 350 plants to the bromeliad collection and perhaps 300 of these are new taxa. We do find that we are getting more selective as the time goes along and our trend is towards species rather than hybrids. At the same time, in similar fashion to the orchids, a number of bi-generic hybrids have appeared. These are more interesting to the plant collector than are hybrids of species. Amongst those received in the past two years are X *Anamea* (*Aechmea* X *Ananas*), X *Neophytum* (*Neoregelia* X *Orthophytum*), X *Neostrum* (*Neoregelia* X *Canistrum*) and X *Nidelia* (*Nidularium* X *Neoregelia*).

One genus new to our collection is *Neoglaziovia variegata* Mez, a monotypic plant from eastern Brazil with foliage and habit very similar to that of *Sansevieria* in the lily family. It is used in its native area for fibre for rope and weaving.

Many of the plants have been flowering very freely and case displays have been put up in the Lobby Court as well as exceptional plants in the Library. Book mate-

rial continues to grow on the subject and for such a relatively small library our coverage is very good.



Upright Bench Layout

New Orchids

Along with the bromeliads the orchid collection continues to expand. We have added to the *Epidendrum*, *Oncidium* and *Encyclia* groups which come principally from Mexico. Perhaps the most interesting additions have been to *Barkeria*. This is a relatively small genus from Mexico and the Thurstons, who have collected several times in that area, brought us several new species.

Considerable virus testing of many of our orchids is progressing and as a result there have been some deletions principally in the bi-generic hybrids of *Laeliocattleya*, *Brassolaeliocattleya* and *Sophrolaeliocattleya* and also in

Cattleya itself. We are testing for Cymbidium Mosaic Virus and Tobacco Mosaic Virus using *Cassia occidentalis* L. and *Chenopodium amaranticolor* Costie & Reynier as test plants. This is a long term project and in a later issue of *The Green Thumb* we will report some conclusions.

Progress is exciting and the way the Gardens are heading with our major collections can be beneficial to the local people and visitors alike. The project of a Conservatory extension is one of the outcomes of the recent fund drive "To Fulfill a Promise." Right now there appears no reason why we cannot have an exceptional collection of plants in the new structure.



Construction begins

Denver Area Garden Soils

Charles M. Drage

The trend in cultivated gardening is for less area, larger yields, and superior quality with a minimum of time, labor, and cost. Mediocre gardens have been relatively easy to have, over the years, because we have a relatively good soil, near unlimited space and the opportunity to control water, timing when it would be used and how much would be used. For many, gardening has been becoming more difficult in recent years. Is there something wrong with the soil?

For the purpose of this article I will consider soil that portion of the earth's crust that supports plant growth, the root zone that provides nutrients, air and water and mechanical support. A mental image of a productive soil would picture a volume of soil that would be approximately 45 percent weathered rock materials, five percent organic matter, 25 percent air and 25 percent water. How closely does your soil meet these specifications?

The majority of the soils in the metropolitan area are brown alluvium, relatively new in origin, poorly developed, excessively well-drained, calcareous and low in organic matter. An exception is the humic clay soils north and east in the Platte Valley with their poor drainage. However, soils are not static and most of us are gardening anthropic soils, soils that have been altered by man. The

modern day description of most local garden soils would include a bountiful supply of minerals (some not available and some available in excessive amounts), a high pH, high total soluble salts, poor drainage, compaction, and a low organic matter content.

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Most of us are affluent gardeners and have burning desires to have better gardens. We are highly susceptible to repetitive advertising and are looking for and using cure-alls on soils that continue to decline in productivity. Our soils are becoming more difficult to work. Now is the time to become better acquainted with our soils, recognize existing problems, review maintenance practices and make changes to overcome problems.

A soil analysis, chemical and physical, can help you become better acquainted with your soil. It can be of value when we understand plant requirements and the effect the various analysis readings have on plant growth. Without these understandings and because a soil analysis report is a composite or average report on the soil in the garden I seldom suggest a soil analysis. The values of quick tests on our basic soils are minimal.

Many gardeners are led astray by reading and perhaps misinterpreting gardening information directed to gardening publics other

than those gardening in western states plant environments. It isn't true that the pH has to be 6.8 to grow beautiful roses or obtain high yields of potatoes. Our experiences are constantly proving otherwise. Frequently the one who suggests the 6.8 pH is asking his reading public to add sufficient lime to raise the pH up to 6.8. He is not asking us to lower the pH of our soils down to 6.8. When we add lime or gypsum to most of our soils we are adding insult to injury.

Is water the limiting factor in gardening in this area? Certainly our gardens would be greatly limited without supplemental water for irrigation. But we do have water and it is interesting to note that farmers and gardeners alike frequently have their most productive seasons in those years when water is restricted.

To know our soils better we must understand the meaning and effects of pH, total soluble salts,

nutrients and their availability, and the physical properties of the individual soil.

Too many people attach too much importance to pH. The acidity or "alkalinity" (really basicity) has little effect on plants. The effects related to it are due to the availability or unavailability of essential nutrients. Plant species, and varieties within a species, vary in their needs for certain nutrients. Our soils with high pH factors may be lacking in available iron, phosphorus, manganese, or zinc. Plants susceptible to deficiencies will express symptoms; deficiencies can be corrected but the treatment may not be practical. After all, we do not need to grow blueberries.

The white stuff we see on the soil in the spring, particularly after a dry winter, may not be snow. It may be soluble salts and we often wrongly call it alkali. It is most



Good Soil Means a Vigorous Garden

apparent on poorly-drained soil but it can be found on high spots on well-drained garden soils. It is the same material that accumulates on the soil surface and rims of porous flower pots, particularly in the arid and semi-arid regions. They may accumulate as a product of parent materials in areas where rainfall has not been sufficient to leach. However, the salt problems of greatest importance develop as a result of irrigation.

Irrigation waters may contain as much as five tons of salt per acre-foot. When irrigation water with a salt reading of four millimhos is used, no amount of it will lower the soil salinity below a level lethal to susceptible plants. Restricted drainage, which may be due to hardened soil layers or hardpans and high water tables, contributes to high soil salinity. It concentrates salts in the root zone. In an increasing number of instances too much fertilizer is applied, and the salt content raised to amounts harmful to plants.

High salt contents limit the uptake of water in plants due to osmotic pressures exerted by the salts. Under extreme saline conditions, the salts may even pull water from the roots. Plant symptoms are often identical to drought or lack-of-water symptoms. All parts of the plant — the stems, leaves, and fruit — will be stunted. Yield and quality will be reduced. The establishment of plants from seed or by transplanting is difficult to impossible in even slightly saline soils. Tip burn and browning of leaf edges frequently occur and are most noticeable in planters or containers where drainage is restricted. The same symptoms occur on trees and shrubs under drought conditions.

Chemical amendments will not neutralize excess salt in the soil. Any soluble material added to the soil will increase the salinity. Salts can be removed only by applying excess water relatively free of salts to the soil surface and washing the salts down and out of the root zone. Leaching is the basic treatment to reduce salt content, but it is impossible to leach without drainage. When drainage has been provided, it may take up to six feet of water to remove or leach the salts out of the soil.

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Plants manufacture nutrients from elements taken from the soil, air, and water. Plant tissues are largely CHON (carbon, hydrogen, oxygen, and nitrogen). Carbon, hydrogen, and oxygen are free, coming from air and water. Ninety-five percent of our total nitrogen comes from the organic matter in the soil.

Our heavy clay and silt soils contain a bountiful supply of the other 12 to 13 elements necessary for plant growth. Biological processes are necessary to convert organics to an ionic state that makes the nutrients available to plants. We are just beginning to recognize, perhaps re-recognize, the importance of organic matter in maintaining soil productivity.

As our soils become more depleted, nitrogen has been recognized as the first element to be in short supply, particularly if the crop is a grass. Phosphate is the second element that may be lacking, particularly where root crops are involved. Potash is frequently found to be in short supply in sandy soils but seldom in silts and clays.

Know the physical properties of your soil. Are the soil particles large or small? Is the organic content high or low? Is the soil well-drained? Apply water in small amounts and more often when the soil particles are small, a high percentage of silts and clays. Loams are mixtures of large and small particles and watering practices are intermediate.

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Add organic matter to your soil to add "life", make nutrients already there available, to serve as a reservoir to bank water and nutrients, and make the nutrient solution available to plants when they call for it. Organic matter becomes humus to increase the particle size in silt and clay soils, to increase pore space and make the soils easier to work. In sands it serves as a blotter to hold water.

Over-watering, under any circumstance, wastes available nutrients and destroys "life" and physical properties. Over-watering may be necessary to lower soluble salt content.

One more word about soil additives, perhaps amendments or conditioners. They have been appearing and disappearing on and from our markets for many years. I started testing some of them as they became available more than 30 years ago. Their success can be more effectively measured in terms of profit making or loss than they can by soil and plant improvement. They do not increase pore space; they do not add nutrients, and they are not what you would like or expect them to be.

For a number of years I have been interested in plant management

systems that seem to increase productivity. Why? Pure hydroponics demonstrated the necessity for liberal quantities of oxygen in the growing medium. Non-tillage methods seem to open-up the soil to provide aeration. Why don't thatch problems develop on lawns where the soil has a high population of nightcrawlers? Is the successful biodynamic/French intensive method of gardening successful because it provides better aeration? I have seen it work here in Fort Collins. Why is complete coring so successful in lawn renovation?

Why do certain rooting mediums produce better-rooted cuttings than others? Try sand and Perlite. Why is the perforated-lined plant pot so successful; is it because air can reach the rooting area? While the athletic turf system provides several maintenance controls I wonder if its ability to provide oxygen is fully appreciated?

I feel that the principal soil problem in gardening in the Denver area today is the lack of oxygen in the soil. Modern land development methods for new construction are leaving compacted soils, some with parched hard pans almost completely impervious to air and water. A secondary problem is poor drainage and high total salts.

It is the wise gardener who studies his soil problems and applies corrective measures. He can start by supplying sufficient organic matter on a continuing basis. He will avoid any practice that will contribute to soil compaction. He will improvise ways to increase soil aeration.

Paleo-botany in Denver

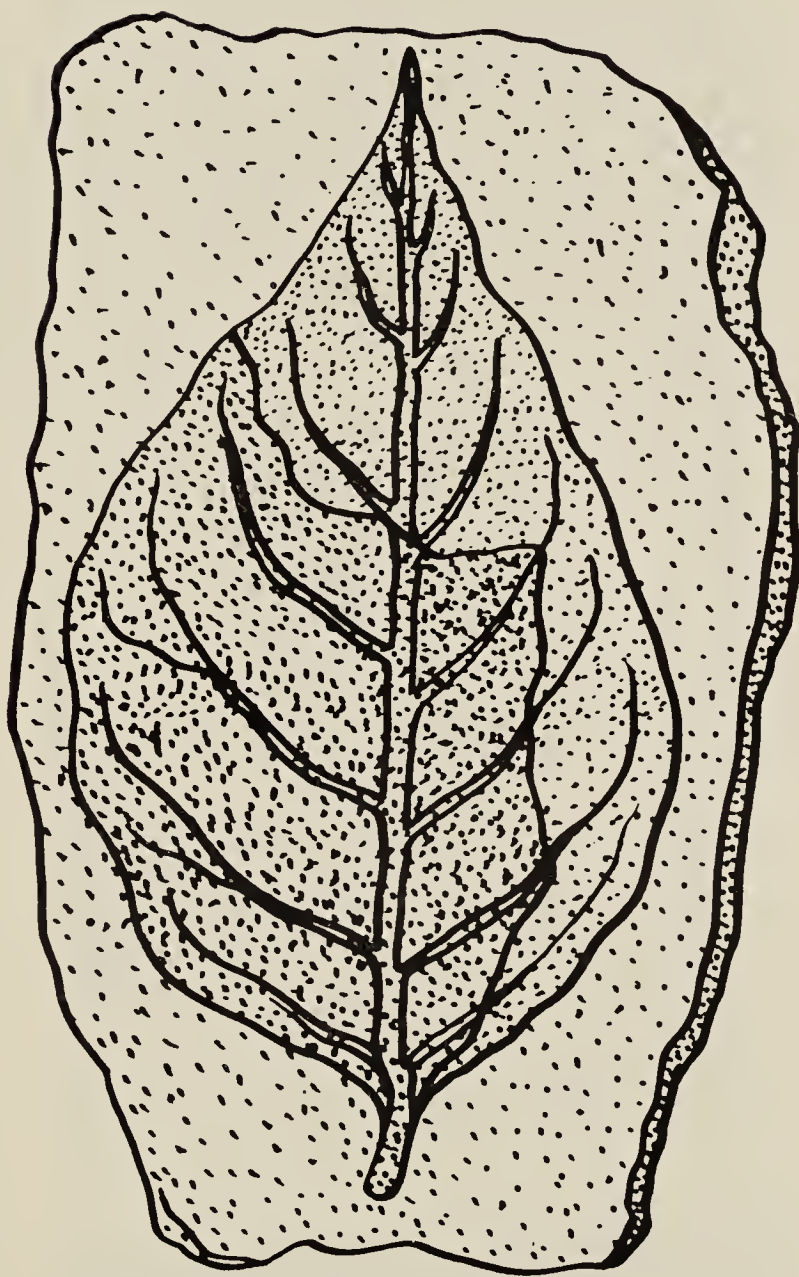
Occurrences of fossil leaves, flowers, ferns, and seeds have been found in several places in the Denver metropolitan area. They are found in different forms of shale or sandstone and usually in the Denver-Arapahoe formation. One of the earliest finds in the area, according to records at the Denver Museum of Natural History, was in the hills just west of Overland Park.

Most of these types of fossils appear to be of Paleocene age. The shales, sandstones, and conglomerates of the Green Mountain area contain a variety of fossil leaves. Some good imprints of palm and other leaves have been found. Positive identification of these leaves has not been made, but many appear to be related to present day living trees. Some have been found that show the complete detail of the leaf. Other imprints are faint with little color or cuticle. The fossil leaves are found in different layers of shale and sandstone, and some have been bent in varying degrees. Some clusters of leaves have been found, along with palm and single leaves of various shapes including oblong, elliptic, and obovate leaves.

Mr. Keith Montgomery is a retired employee of the United States Mint who has made a hobby, since his retirement, of the study of paleontology. He attended Colorado State University and spent some time during the '30s in the mines in Nevada. He keeps a close watch on excavations for buildings in and around Denver and with the permission of the contractors and architects has searched for fossils through the piles of dirt.

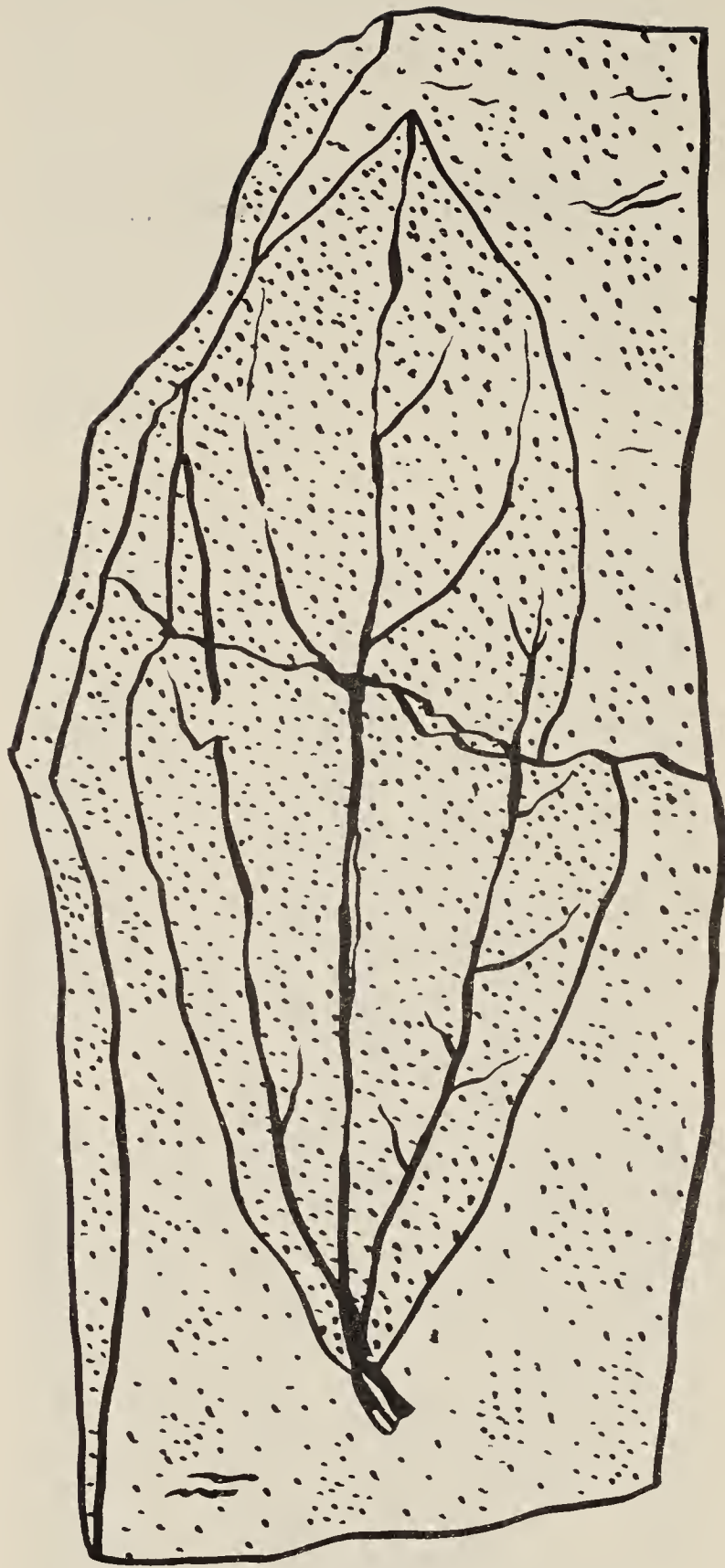
Keith R. Montgomery

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Denver Fossil Leaf

These fossils do not occur in all of the shales and sandstone. They seem to concentrate in different locations that appear to have been



Denver Fossil Leaf

ancient bogs or settling ponds. The shale beds of different places dip greatly. Some of the beds are near the surface in one place and dip beyond the area where excavations have been made. Petrified palm and other wood, as well as plant stems and seeds, have been found in this area

Petrified wood and bones of mammoths and camels have been

found in various places in the Denver area. During the excavation for the building of South Denver High School, bones of camels were uncovered.

During the excavation for the building of the Denver General Hospital Parking Garage, evidence of an ancient river channel was exposed at about 18 feet. Water-washed boulders, sand, and gravel appeared. Pieces of small bones and petrified wood including two pieces of petrified palm wood about 18 by 6 inches were exposed. Several smaller pieces of palm and other petrified wood were present. This apparently is part of what is known as the Broadway Terrace, named after the main thoroughfare in Denver.

Downtown Denver and much of the adjacent area is built on the Broadway terrace, and excavations for large buildings have exposed sand, gravel, bones, and petrified wood. Buildings are anchored in the bedrock that underlies the gravel. The Geological Survey and others have been aware of this ancient river channel for years and references are made to it in several publications.

As the rapid amount of building and expansion continues in the Denver metropolitan area, places where fossils might occur are being covered with asphalt, concrete, buildings, homes, and parking lots. This probably eliminates discovery of fossil materials in these areas for all time.

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Good Grapes for Local Gardens

Moras L. Shubert

The grape vine is not seen as often as it should be in our home gardens, so perhaps a little encouragement is in order to get more grape culture going in Colorado. When I first came to Colorado, I was told that "Grapes do not do very well here, you can only get a crop about 2 or 3 years out of 5." But having been a grape grower in another state, I was convinced that our environment was not unsuitable, so I proceeded to plant several of the "old favorites" such as Concord and Niagara in my garden. That was over 25 years ago. In all these years there has not been a year when we did not get at least a few grapes, and most years we have harvested more than we could use and give away. I have even had to put some in the compost heap when the crop was heavy! So don't let anyone tell you that you can't grow grapes in gardens in our Front Range cities (and surely in any irrigated garden).

In "promoting" grapes, I will touch on these topics: soils and planting considerations; care of vines, training and pruning; varieties of interest for the high plains gardens; some of the uses of the vines and their products.

Dr. Moras L. Shubert, Secretary of The Denver Botanic Gardens, is retired from the Botany Department, University of Denver. He has written many articles for *The Green Thumb*.

Any good loamy soil, preferably rather rich in organic matter, is good for grape vines. If the soil in your garden site is heavy clay, introduce compost, peat, or well-rotted manure in generous quantities to improve the texture. Your planting stock can be bare-rooted or container grown, but I see no reason for the extra expense of container grown plants if fresh, vigorous 2-year vines are available. You can also get vines from existing ones very easily by layering canes. To do this, lay a cane down in a small depression, cut a small notch in one side of the cane to encourage rooting, then cover the cane with at least 18 inches of leafy growth protruding and perhaps put a brick or heavy rock over the covered part to hold it steady in the soil. By the end of the growing season, you should find a nicely rooted vine which can then be severed from the parent vine and planted in the place where you want it.

Be sure to dig a hole of generous size and spread the roots out as you cover them. When the hole is nearly filled with soil, flood it with water and let all the water seep in before filling with the last 4 or 5 inches of soil. If you are planting in the autumn, use a thick mulch of leaves or coarse straw to hold the moisture and prevent excessive freezing. Actually, early spring planting is safer, and the method is the same, except that you need

not use mulch. Vines should be spaced 8 feet apart.

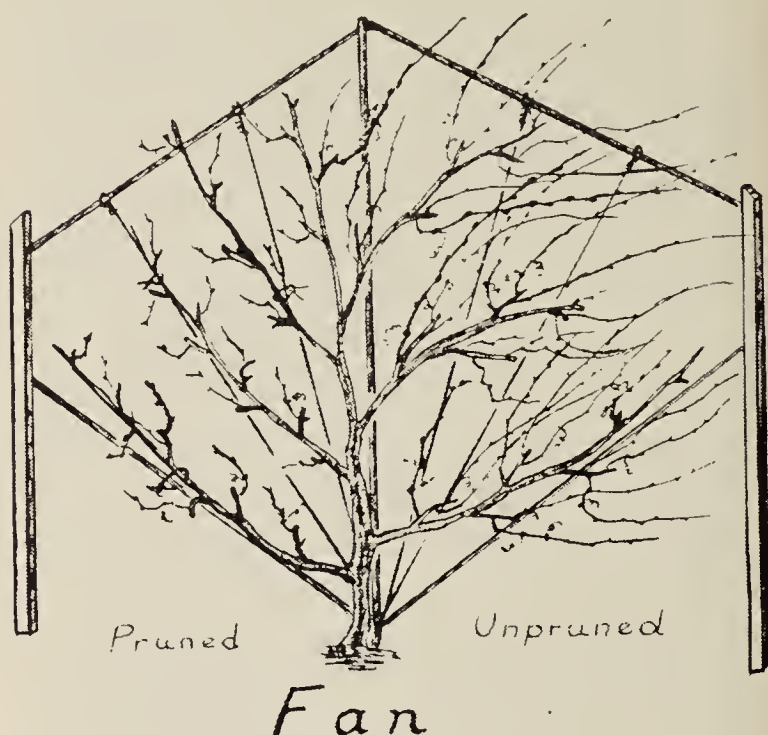
Do not use mineral fertilizers until after the newly-set vine has made at least 18 inches of growth. This will tell you that all is going well with root development and the roots can then accept a mineral fertilizer without damage. Irrigation should be deep and plentiful, but not too frequent. If you provide about 2½ inches of water in the area of the vine once a week, that should be adequate. And when the vines begin to bear, probably in the second year, reduce irrigation after the grapes get to be nearly full size. This will hasten ripening and improve richness of flavor.

Care of Vines: Training and Pruning

Fruit set is on the new growth of the current year. This means you should train your vine in such a manner as to permit bud growth from the most productive of the canes formed in previous years. Training, therefore, should be started during the first year of growth with the future shape of the vine in mind. If you are going to use a wire trellis or fence to support the vine, you will want to fasten the most vigorous cane of the first season to a post so that it will grow up to about 5 feet, and if it is inclined to continue growing upwards, cut the top off at about 5 feet to promote lateral branching.

If a trellis over a walkway or patio is desired, you may wish to train to a fan pattern. In this case, save three good canes the first year, and remove any others. Allow the three to grow to no more than 4

feet and head them off by cutting the ends at that height. When a vine is used both for shade and fruit production, you will usually have to sacrifice somewhat of fruit production, because you will want to have more vegetative growth than is best for fruit production.



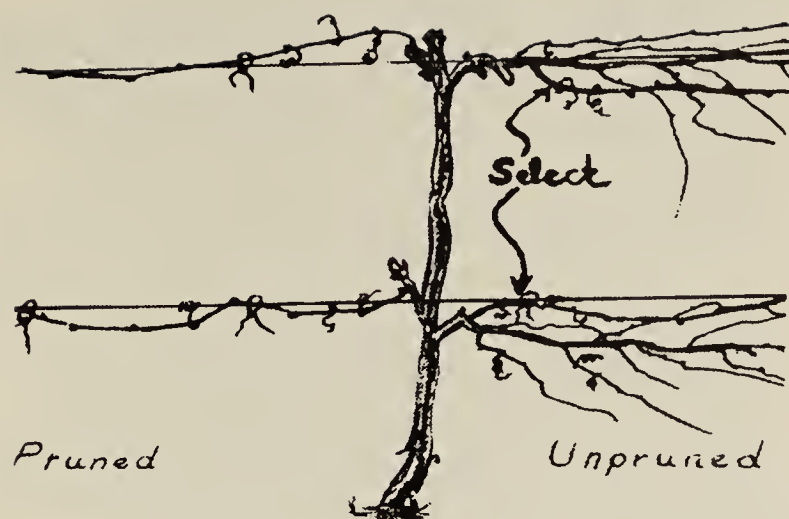
When pruning for the second year and succeeding years, the rules are simple, but very important. The best time to prune is in February or early March, but any time before the buds swell for new growth is all right. If you prune late and see "bleeding" do not worry. It has been proven that this does not weaken the vine. Save the more vigorous canes, and completely remove, back to the main stem, any weak canes and any which seem to be overly vigorous. These latter are known as "bull canes" and they are excessively thick and long — too vegetative. The most fruitful canes to save are about the diameter of a wooden lead pencil and the spaces between the buds are about 5 or 6 inches long. On a lateral wire trellis, it is a good idea to save four canes, two at the top, one going each way and each of them with about ten

buds (remove the ends if they are longer than that). Likewise, two lower canes, halfway between the top and the ground, should be pruned to about eight buds. This is the old time-tested "4-arm Kniffin System" of training and pruning. You will see that you are saving a total of about 36 buds for fruiting, and with an average of two, perhaps three, bunches of fruit per cane developing from each bud you can have enough bunches of fruit from one vine nearly to fill a bushel basket.

If you are using a fan-shape system, you will want to save more buds than this. I recommend that you save the kind of canes, mentioned above, but more of them, keeping the total to no more than 60 buds. In other words, you may want to cover a shade trellis by keeping more than four canes, or you may want to keep canes with more than ten buds. When all pruning is done, fasten the canes which have been saved by tying them loosely to the support, but be sure to allow space for the cane to double in thickness. Otherwise, you will have a choked cane before the season is finished. Any material which is easily available for tying can be used, such as string, yarn, Twistems, or wire. Do not use rubber bands or adhesive tape, however.

Varieties of Interest for High Plains Gardens

Recommendations of varieties can be based only upon observation and a certain amount of "crystal-ball gazing". We started a test of varieties at Denver Botanic Gardens before the present Master



Four-Cane Kniffin

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Plan was put into operation. Unfortunately our test vines had only two years of growth before they were plowed out, so our tests were not adequate. We are looking forward to an experimental vineyard in our Chatfield Arboretum which will give us reliable records to support recommendations in the future.

Varieties which are of American species, mostly from selections of *Vitis labrusca*, or hybrids between it and French varieties are the best for our conditions. Although I have tried the European variety, Thompson seedless, for many years, it has not done more than give vigorous vegetative growth each summer and almost no fruit. Therefore, I cannot recommend any of the *Vitis vinifera* varieties for Central Colorado.

As most people know, grapes are classed into three general color classes, blue, red, and white, so the following descriptions will be given in that order and performance is based upon my personal experience (pe), observation in the Denver area (o), or upon literature (l).

Blue Grape Varieties:

Concord — The “Welch Grape-juice” type. An all-time favorite for jams, jellies, and conserves as well as unfermented juice. It has been a satisfactory producer for me for over 20 years. (pe)

112 Fredonia — Although it is a “Concord-type” as to color, it ripens a week or two earlier and to me has a milder, more pleasant flavor. My vine is in too much shade, so does not set fruit as copiously as it could. Grapes do need good sunlight. (pe)

Steuben — Again, similar to Concord, and worthy of trial. (l)

There are a number of other blue grapes which should be tried, but for one reason or another, I do not think they are worthy of mention at this time. Some are of doubtful quality and hardness.

Red Grape Varieties:

Agawam — This variety is an almost lost one, but I think it should be restored. It is probably a hybrid, but its parentage is a bit shady. It produces small bunches of large berries which have a most distinctive spicy flavor. I like it just for eating, but it does make a nice red jelly. (pe)

Caco — This variety has been planted as the one red grape in this region for many years. It is actually a pink color, not really red (like Agawam). I have seen it produce very well some years, but it may be a bit erratic. (o)

Seibel 10868 — Reported to be a vigorous vine and good for a burgundy type wine. Recommended to

be pruned to many very short canes (sometimes called spur pruning, as in the California vineyards). (l)

Baco Noir — Produces a claret type wine, and reportedly is a vigorous grower in our type of climate. It is ripe early, so should be a good bet for trial. (l)

White Grape Varieties:

Niagara — For over 20 years this has been my best producer, and its fruit when fully ripe is a slightly amber color and translucent. It is sweet and has a pleasant bouquet, but it is not good for wine. It makes a nice clear jelly, or it can be mixed with Fredonia or Concord to give color. We like it mainly for eating fresh. (pe)

Villard Blanc — Reported to be hardy, but late in ripening, so might be caught by an early snow or frost. Can be used for a white wine. (l)

Ravat 51 — Produces a chablis type wine, and is reported to be hardy in our climate. It ripens in mid-season, about the first week of September. (l)

Aurora — Also reported to be good for a delicate white wine, and can be used as a table grape. An early variety. (l)

Seibel 9110 — Description similar to the above, but it should be spur pruned. May not be very winter-hardy unless protected. (l)

Seyve Villard 50-276 — Produces a chardonnay type wine; spur prune. It should ripen about the time of Concord. (l)

Catalogs list other varieties, such as Interlaken, which I have not enough information at this time to include. We did try seedless Concord and although it was removed after only one season of fruiting, it had very tasty, small bunches of small dark berries in rather good quantity. It is worth trying.

Some Uses of Vines and their Products

A grape vine, when given proper care, can be as beautiful as any other decorative foliage in the garden, and of course it is truly exciting when filled with bunches of grapes. It will make a dense shade on an arbor, so it is suitable for shading a patio (with the reservation that it may be messy when the fruit ripens). A nicely arranged trellis can make an excellent screen for privacy or for a border, perhaps behind perennial flowers.

The American varieties are not at all good for wine, as they have a hearty flavor, usually described as "foxy". But they do make pie fruit, wonderful jelly and conserve. Although they have sufficient pectin to jell without additives, we have found it takes less cooking and preserves the freshness of flavor to add a pectin and use much less sugar than the packages of pectin recommend. We use no more than cup per cup — sugar to juice.

The varieties I have listed for wine are all French-American hybrids. I have not tried any of them, so cannot vouch for their quality. Certainly, it would be interesting to try some of them and the wine, wouldn't it?

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(Readers are cautioned that California publications on grapes deal almost exclusively with the European grapes which are not suitable for our region.)

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Site of Orchid House



Rainbows in Plant Colors

Patricia H. Duhnkrack

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All of us take the green color of plants for granted and have an understanding of the importance of chlorophyll in the changing of solar energy to food.

But, we are always pleased to see the other colors in plants. Flowers, fruits, and variegated leaves are often the eye-catching parts of the plant, as they show off the other colors of the spectrum. Sometimes the reds, oranges, blues, and yellows are there but invisible, masked by the ubiquitous green. These colors are not only there for our visual pleasure but also function in the growth and life cycle of the plant.

The orange and yellow colors are grouped with chlorophyll because they are also found in the chloroplasts (the small photosynthetic units within the cell) and take part in the foodmaking process. They are found in more abundance in plastids called chromoplasts. The reds and blues are grouped separately because they are found dissolved in the cell sap and are important because of the colors themselves, not because of a metabolic role. These pigments are of special interest because of their non-photosynthetic roles.

The red and blue pigments are chemical compounds known as anthocyanins. They are found in the cell usually in combination with various sugars; in fact, their initial production depends on a supply of carbohydrates. An excess of available carbohydrates often results in an excess of the pigment; this is apparent in the reds of fall foliage. Here, the vascular system becomes blocked as the leaves develop a corky layer at the base of the petiole, and the carbohydrates produced by photosynthesis are unable to move out of the leaf. The chlorophyll is broken down, and the reds have a moment of supremacy.

In flowers and fruits, the anthocyanins have evolved as an incentive for furthering pollination and seed dispersal. The bright colors of flowers attract insects which distribute pollen and increase chances of crossbreeding. Bright colored fruits attract feeding birds and mammals who scatter the seeds over larger areas.

The chemical compounds making up anthocyanins are easy to identify and trace. They have become tools for geneticists and taxonomists. Mendel's pioneering experiments in genetics depended on the ability of garden peas to manufacture the pigment of violet-red. The color of the flower is an inherited characteristic, easily identified

Mrs. Patricia Duhnkrack has been a Conservatory Guide for the Gardens for two years. She had an article in the Autumn Issue of *The Green Thumb*.



Linum lewisii — a blue flower

and counted. Mendel crossed a red garden pea with a white garden pea, and observed that the results of this cross, called the “first generation”, produced only red flowers. Crossing two members of this generation produced both red and white flowered plants, in a three to one ratio. From this information, and that derived from other basically simple experiments, Mendel was able to formulate the theory that each inherited trait was determined by two factors, what we now call “genes”, one provided by each parent. If a gene for the production of anthocyanin is present, the flowers will be red, as this is dominant over the gene for the white color.

Not all patterns of inherited flower color are as simple as the one Mendel was fortunate enough to work with. Flower color is often determined by more than one gene. Three or four genes interacting will cause continuous color variation, rather than a sharp distinction, as with the red and white in Mendel’s work. Sudden changes in genes, known as mutations, can cause equally sudden changes in the plants. Such mutations are

usually harmful to plants, but, occasionally, as in a dramatic new flower color, the grower can take advantage of the mutation and attempt to breed it for future stock. Present day efforts to produce a blue rose are based on primary genetic principles and modern knowledge of the chemical structure of red and blue anthocyanin.

These plant pigments react like the litmus paper of the chemistry lab; the more acidic the soil, the deeper the red; the more alkaline, the bluer the flower. The eastern hydrangeas are good indicators of soil conditions.

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Sometimes anthocyanins are credited with playing a more metabolically active role in the growth of the plant. The pigments, because of their colors, reflect the light rays that are injurious to the plant’s metabolism; the photosynthetic pigments are “protected” by the anthocyanins. The more intense the light rays the less green the leaf will show. Chlorophyll is more easily destroyed by the action of ultra-violet and infra-red rays of the sunlight; thus, the brighter the light the more the other pigments are visible to the human eye. The patterned leaves of the croton show this reaction to sunlight. They usually reveal both the anthocyanin and photosynthetic pigments at the same time. The anthocyanin pigments look red and purplish, the carotene and xanthophyll look yellow and orange, the remaining chlorophyll looks green.

The anthocyanin compounds are also capable of converting light rays to heat energy, rather than food energy. Tropical studies have shown that lower leaves of large plants often have a higher antho-

cyanin content and a higher internal temperature than the upper leaves, even though they are in a more shaded position. This increase in temperature stimulates growth, metabolism, and movement of food and raw materials within the plant.

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In contrast to chlorophyll, anthocyanin production is not dependent on light — witness the beet and the radish. When leaves are young and chlorophyll has not had the time to be formed anthocyanins are more visible. Young maple leaves and their petioles are often red, as are oak leaves and the center leaves of many bromeliads. As a plant matures, the green pigment develops and masks the red.

A plant can modify the color of its pigments. A pale tint is sometimes the result of a dilute pigment within the cell, often the result of a large number of air spaces between the cells. The whiteness of the gardenia exemplifies this phenomenon, as does the whiteness of snow and ice. Here, the whiteness is caused by the myriad of air spaces packed between the crystals; really solid ice is clear like glass.

Frequently, the overlapping of pigments within the cell structure gives us the range of color we have come to expect from plants. For example, the orange flower of the nasturtium is produced by a red anthocyanin plus the yellow carotenoid pigments. The greyish or blue cast often seen in green desert plants is caused by a covering of hairs or a modifying layer of wax, both of which serve to protect the plant from excessive sunlight.



Helenthella parryi — a yellow flower



Castilleja miniata — a red flower

We owe our ability to see plant colors to the plants themselves. Green plants have the unique ability to produce carotenoids, chemical substances upon which animal vision is dependent. Carotenoids are manufactured only by plants, and must be ingested by animals in order for the vision mechanism to function. Plants not only provide the colors for us to enjoy, they also provide us with the capability to enjoy them.

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In simpler plants, those not very far along the evolutionary scale, plant color is mainly restricted to photosynthetic pigments. Colors evolved as reproduction became more complex and plants came to depend on attracting animals for reproduction and dispersal. The tendency in evolution has been towards the blue end of the spectrum, as insects are most attracted by these colors. There has also been a trend to more chemically complex pigments, the anthocyanins, as these are more stable with regard to light and enzymatic attack. Man has played a big role in pigment production by breeding plants for ornamental use.

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DENVER'S ELITCH GARDENS

Bill Anderson

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Elitch Gardens which started in 1890 as a zoological garden and amusement park, was for many years famous for its flowers. The site of the gardens, at 38th Avenue and Tennyson Street, was originally part of an orchard of fruit trees.

Mr. and Mrs. John Elitch, who established the Gardens, were very much interested in the theater, and the Zoo in the orchard soon became the site of the summer theatre, which it still is.

Elitch Rock Garden

The greenhouses in which thousands of flowering plants were raised are largely gone, and the outdoor flower beds are greatly diminished in size but there still is an Elitch Gardens worthy of the flower lovers' attention. The company employs a full time horticulturist who maintains a continuing procession of blooms throughout the area with emphasis still on hanging baskets. But the magnificent dahlia beds are now a parking lot!

For many Denverites, and summer visitors to Denver, the outdoor gardens of the early 1900s were a



spectacle to which many returned week after week as the procession of blooms stretched through the summer. The greenhouses provided thousands of flowers. The walks in the gardens were shaded by pergolas from which were hanging baskets filled with blooms. The walks were outlined by flower beds.

In the late summer and early fall the dahlias lining some of the walks and filling a bed on the west attracted much attention. Many people were photographed in front of the flowers rising above them. In the late 1920s a Denver newspaper reporter used a step-ladder as a platform from which to photograph dahlia blooms thirteen feet above the ground.

The blooms in the accompanying picture are not that high but the picture shows flowers which delighted thousands of visitors.



Old Entrance Gate

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Tall dahlias.

Peace Rose Named For "World's Desire"

H. E. Owen

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It was no coincidence that when the United Nations first met in San Francisco, the building was practically surrounded by gardens featuring the Peace rose.

I shudder every time I think of all the things that could have happened which would have prevented our enjoyment of the Peace rose. The seed, about the size of a pin-head, could have stuck in the container or in some way been lost on the floor; it could have been eaten by a mouse or bird; the seedling could have been nibbled by a rabbit; and so on *ad infinitum*.

Amazingly, the last plane to leave France for the United States before the occupation by Hitler's armies carried a package containing a few twigs of bud wood sent to Mr. Robert Pyle, founder of Star Roses. By 1945, under Mr. Pyle's guidance, the rose, 3-35-40, had been thoroughly tested throughout America.

These trials were so successful that the rose 3-35-40 was given a unique honor. The American Rose Society gave it a "Name Giving Ceremony" in Pasadena, California on April 29, 1945. Mr. Pyle suggested, and I quote, that "this greatest rose of our time should be named for the world's greatest desire: Peace." His suggestion was accepted, coincidentally, on the day the Allies occupied Berlin.

The seed of the Peace rose resulted from a 'Frances Meilland' cross made in Tassin, France in the spring of 1935. Mr. Meilland gave the seedling the number 3-35-40 and by 1939 the obvious qualities of the rose were well recognized in Germany and Italy where the rose was sold under the names 'Gloria Dei' (Glory be to God) and 'Gioia' (Joy) . . There were no plant patent laws in Europe at that time.



Rose Garden

The Peace rose is the yardstick against which all new roses are measured. It sets standards in flower size, foliage health and appearance, bush size, and disease and insect resistance which are still, some 35 to 40 years later, criteria of the highest magnitude. Until 'First Prize,' no other rose has really "measured up" to Peace (this is a personal opinion, not necessarily accepted by other rose fanciers).

The royalties accruing to the Meilland family from the Peace rose have allowed the Meillands to expand their hybridization and rose growing immeasurably. They, for example, have established an international network of rose growers representing 25 countries, called the Universal Rose Selection Group. These growers assist each other in selecting, testing, and growing new roses. The royalty money allowed the Meillands to move their headquarters from the Lyon region of central France to Antibes on the Riviera where roses can be grown the year around. Thus, from the Peace royalties, a quantum jump occurred in the Meilland family fortune, and rosarians the world over have been reaping the rewards in the form of Meilland hybrid roses.

There are now well over 30 million Peace rosebushes grown all over the world. I, myself, have seen them growing in gardens in Jordan in the Near East. I have had the opportunity to observe potted roses for sale in Amman, Jordan where over half of them were Peace roses. I have seen a Peace rose bush which had a main stem over 3 inches in diameter, growing in the Roman Forum ruins. I have no idea how it got there, but there it was, growing by an ancient statue of the Vestal Virgins. Perhaps it was planted by some Roman celebrating the end of World War II.

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No other rose variety has meant so much to so many people, for it has brought so much beauty to the world. To me, when I hear the word "rose" I visualize the Peace rose first! It has an aura about it that is unique and truly outstanding!

H. E. Owen, Ph.D, is a former professor of Fort Lewis College. He is a past president of the Four Corners Rose Society and an accredited rose judge. Presently he is Director for Scientific Liaison of the Bio-Systems Research in Salida. This article appeared in *The Rose Window*, Newsletter of the Denver Rose Society, and is reprinted with his permission.



Exotics of Colorado

Eastern Arbor-vitae

Thuja occidentalis

Helen Marsh Zeiner

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It would be highly unlikely to find eastern arbor-vitae, *Thuja occidentalis* L., on any list of evergreens recommended for the Denver area. Arbor-vitae have proved to be very difficult for our soils and climate, usually developing an undesirable chlorotic color, or turning brown and soon dying. However, one can occasionally find a beautiful arbor-vitae which has managed to survive and even thrive. Such trees are usually in a protected area on the north or east of a house, and have had special care by an understanding gardener.

In nature, the eastern arbor-vitae grows in cool, wet locations such as swamps, beside streams or lakes, or in moist fields. It thrives in moist, loamy soil. Arbor-vitae is to be found from Nova Scotia west to Manitoba and from New England and New York west to northern Minnesota. It extends south into the mountains of North Carolina and eastern Tennessee. Trees in their native habitat are often 50 - 60 feet tall, but in the southern part of their range they are reduced to shrubs. About 50 horti-

cultural varieties have been developed, mostly small trees or shrubs suitable for landscaping. Horticultural varieties are noted for variations of color or shape. For example, some arbor-vitae are yellow or bronze, and there are pyramidal, dwarf globose, or dense conical forms.

From a distance, an arbor-vitae looks much like a juniper, although the color is a brighter, more yellowish green. From a close view, it is obvious that this is not a juniper. What distinguishes the arbor-vitae are its flattened branchlets which are so flat that they appear to have been pressed. They are sometimes described as frond-like. The tiny leaves are scale-like and are arranged in overlapping rows of alternating pairs. Indians called this tree "oo-soo-ha-tah," meaning feather-leaf, a good descriptive name for the flattened sprays.

The upright cones of arbor-vitae are small and urnshaped, composed of four to six pairs of thin scales. They are very different in appearance from the fleshy cones or berries of the juniper.

We know arbor-vitae for its use as an ornamental, but in its natural

Dr. Helen M. Zeiner is the Honorary Curator of the Herbarium, Denver Botanic Gardens, and a member of the Editorial Committee. "Exotics" appears several times a year in *The Green Thumb*.

range it has many other uses. The wood is soft, brittle, and rather coarse-grained, but very durable in contact with soil or moisture. This makes it useful for telephone poles, railroad ties, fence posts, buckets, cooperage, tanks and cisterns, and canoe frames. It is also used in construction and cabinet making. The leaves and twigs contain an aromatic volatile oil used medicinally.

An interesting fact about arbor-vitae concerns the mammalian brain. Because of its striking resemblance in section to the foliage of an arbor-vitae, the white matter of the mammalian cerebellum bears the name "arbor vitae."

Arbor-vitae literally means "tree of life." *Thuja* is an ancient Greek name for a resinous tree or shrub. *Occidentalis* indicates that this is a plant of the western hemisphere.

If you are an adventurous person and wish to gamble on an arbor-vitae, be sure to buy from a local nurseryman. You will be more apt to get a hardy strain with a better chance of survival in Denver.

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Thuja occidentalis

Local Botanists Honored

Bill Anderson

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Two well known Colorado botanists and horticulturists were given Certificates of Merit at the July conference of the American Association of Botanical Gardens and Arboreta. The local recipients were Mrs. Ruth Ashton Nelson and Mr. George Kelly.

The bronze plaques for long and devoted service to botany and horticulture, were presented by Richard Lighty, President of the Association.

Mr. Kelly has been active in horticultural work in Colorado for many years. He was a founding member of the Colorado State Forestry Association in 1943. He served as the first editor of *The Green Thumb*. When the Botanic Garden Foundation of Denver was formed in 1951 Kelly became a charter trustee of the new organization. Now retired and living in western Colorado, Mr. Kelly has maintained an active interest in the Botanic Gardens. He is the

author of *Rocky Mountain Horticulture is Different*. Others of his popular books include *A Guide to the Woody Plants of Colorado*, *How to Have Good Gardens in the Sunshine States*, *A Way to Beauty*, and *Trees for the Rocky Mountains*.

Mrs. Ruth Ashton Nelson has been a student and teacher of botany in the Rocky Mountain region for many years. She has written a number of articles for *The Green Thumb*. She is the author of three books on the flora of this region. The first *Plants of Rocky Mountain National Park* has been through several editions, the current one being published by the Rocky Mountain Nature Association. *A Handbook of Rocky Mountain Plants* was her second publication which is now in its second edition. *Plants of Zion National Park* is her latest book.

Mrs. Sweeney, of Florida, was the third recipient of the A.A.B.G.A. award.



Left to right: Richard Lighty, Ruth Ashton Nelsen, Mrs. Sweeney, George Kelly.

In Memory of Katharine Crisp

Katharine Bruderlin Crisp, 1884 - 1979, was a member of the Editorial Committee of *The Green Thumb* from its earliest years until her death last month, its chairman for five years, and an honorary life member of Denver Botanic Gardens. She was a past president of Home Garden Club of Denver and the first president of Around the Seasons Club.

Her life work was teaching. Her life interest was plants — the native wildflowers, shrubs, and trees of Colorado, and trees and shrubs for landscape planting. After 39 years of school teaching she retired, but she continued to combine her work and her love by sharing her great knowledge of nature with dozens of friends and acquaintances. She continued, too, to lead nature hikes for garden clubs, for The Colorado Mountain Club, and for students. Whether in the mountains or on the plains those of us who went on field trips with her remember with affection and nostalgia this willingness to share. In fact, her patience and understanding of plants and people was the catalyst in 1960 for the formation of Around the Seasons Club, a service organization of volunteers who wanted to support Denver Botanic Gardens.

Born of Swiss parents in Denver, May 23, 1884, she spent her first three years of school at Barr Lake in a one room schoolhouse. After

that came the Denver public schools, the University of Colorado where she earned her A.B. and M.A., majoring in mathematics, German, and the biological sciences; then summer sessions at the University of Colorado Mountain Laboratory at Tolland, at the University of Chicago, and at Columbia University.

She taught math, German, and biology in Brighton and Loveland and at North High School in Denver; then for the last 20 years of her career she taught her main love — botany and biology at East High School in Denver.

While at East High Mrs. Crisp wrote three books on health which were standard textbooks in the Denver Public Schools and throughout the nation. She ceded the royalties on these books to the DPS and is reported to have earned over \$50,000 for them. *Growing into Maturity*, a booklet published in 1939 with a second edition in 1944, was probably the earliest publication on sex education in modern terminology. She also wrote many articles for *The Green Thumb*, mostly on trees and shrubs for planting, and for *Trail and Timberline* (The Colorado Mountain Club magazine), mostly on wildflowers. She had articles published in the *University of Colorado Studies*, in *Nature* magazine, in *Municipal Facts* (Denver), and in other periodicals.

In 1932 she married William H. Crisp, a well-known Denver ophthalmologist, who died in 1951.

Articles about her have appeared in the *Rocky Mountain News* and in *The Denver Post*. Her picture appeared on the cover of the Roundup section of the Post in May 1973.

126 For her Master's thesis in biology in 1933 she wrote about her favorite subject, *Trees of Denver*, in which she attempted to show how successfully trees are grown in this area. In all, she listed 76 species and measured 274 of the prominent trees locating them on hand detailed maps. A handbound copy of her thesis is a part of the Denver Botanic Gardens' library reference collection.

She was a life member of The Colorado Mountain Club, secretary from 1920 to 1923, active in its photography division, and a leader in its walks program. She climbed 25 of our 54 mountains over 14,000 feet high. She, also, was an active "birder" with the Denver Field Ornithologists.

Although she scoffed at the popularity of the term "ecologist," Mrs. Crisp later admitted good-naturedly that she was an ardent one. "Naturalist" was the description she preferred and the word which most vividly portrays this gentle little teacher who made a positive impact on hundreds of students and on many of the dedicated volunteers at Denver Botanic Gardens.

Elinor Eppich Kingery
Bernice E. Petersen



Katharine B. Crisp

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